B.E. MECHANICAL ENGINEERING

CURRICULUM

(2018 AND ONWARDS)

(REGULAR PROGRAMME)

Department of Mechanical Engineering
FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

Established Under Section 3 of UGC Act 1956

Pollachi Main Road, Eachanari Post, Coimbatore – 641 021.INDIA

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act, 1956)

Eachanari Post, Coimbatore-641021.Tamilnadu,India.

FACULTY OF ENGINEERING

B.E. (MECHANICAL ENGINEERING)

COURSE OF STUDY AND SCHEME OFEXAMINATION

(2018 Batch Onwards)

SEMESTERI										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME101	Mathematics-I (Calculus and Linear Algebra for Mechanical andAutomobile Engineering)	1	1,2,8, 9	3	1	0	4	40	60	100
18BEME102	Electro Magnetism	1, 3	1,2,3,5, 8,9	3	1	2	5	40	60	100
18BEME103	Basic Electrical Engineering	1, 3	1,2,3,8 ,9,11	3	1	2	5	40	60	100
18BEME311	Engineering Graphics-I	1, 2	1,2,3, 5,9	1	0	4	3	40	60	100
			Total	10	3	8	17	160	240	400

SEMESTERII										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME201	Mathematics-II (Calculus, Ordinary Differential Equations and Complex variable for Mechanical and Automobile Engineering)	1	1,2,8, 9	3	1	0	4	40	60	100
18BEME202	Chemistry I	1	1,2,5, 10	3	1	3	6	40	60	100
18BEME203	English	2	4,5, 10	2	0	2	3	40	60	100
18BEME204	Programming for problem Solving	1	1,2,9	3	0	4	5	40	60	100
18BEME205	Constitution of India			1	-	-	-	100	-	100
18BEME211	Workshop / Manufacturing Practice	1, 2	1,2,3,5	1	0	4	3	40	60	100
18BEME212	Engineering Graphics II	1, 2	1,2,3, 5,9	1	0	3	2	40	60	100
			Total	12	2	16	23	340	360	700

SEMESTER III										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME301	Mathematics III	1	1,3,5,6,7,8	3	1	0	4	40	60	100
18BEME302	Biology for Engineers	1	1,3,5,6,7,8	3	0	0	3	40	60	100
18BEME303	Engineering Mechanics	1	1,2,3,4,10,11	3	1	0	3	40	60	100
18BEME304	Thermodynamics	1	1,2,3,4,10	3	1	0	3	40	60	100
18BEME341	Basic Electronics Engineering	1	1,2,3,4,10	3	0	2	4	40	60	100
18BEME311	Machine Drawing	1	1,2,3,4,10	2	0	3	4	40	60	100
18BEME351	Aptitude Training	-	-	1	0	0	-	100	-	100
18BEME352A / 18BEME352B	Welding Process / Welding Metallurgy	-	-	2	0	0	-	100	-	100
18BEME353	Material Testing Laboratory	-	-	0	0	3	-	100	-	100
			Total	20	3	8	21	540	360	900

SEMESTER IV										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME401	Instrumentation & Control systems	1	1,2,3,4,10	3	0	0	3	40	60	100
18BEME402	Environmental Studies	1	1,2,3,4,10	3	0	0	3	40	60	100
18BEME441	Engineering Materials and Metallurgy	1	1,2,3,4,10	3	0	2	4	40	60	100
18BEME442	Applied Thermodynamics	1	1,2,3,4,10	3	1	2	5	40	60	100
18BEME443	Strength of Materials	1	1,2,3,4,10	3	1	2	5	40	60	100
18BEME444	Fluid Mechanics & Fluid Machines	1	1,2,3,4,10	3	1	2	5	40	60	100
18BEME451	Technical Presentation	-	-	1	0	0	-	100	-	100
18BEME452A / 18BEME452B	Welding Economics and Management / Process Modeling	-	-	2	0	0	-	100	-	100
18BEME453	Mini Project I on Welding	-	-	1	0	0	-	100	-	100
			Total	22	3	8	25	540	360	900

SEMESTER V										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME501	Design of Machine Elements	1	1,2,3,4,9	3	1	0	4	40	60	100
18BEME541	Heat and Mass Transfer	1	1,2,3,4,5	3	1	2	5	40	60	100
18BEME542	Manufacturing Technology I	1	1,2,3,6,8,9	3	0	2	4	40	60	100
18BEME543	Theory of Machines	1	1,2,3,4,10	3	1	2	5	40	60	100
18BE_____	Open Elective I	-	-	3	0	0	3	40	60	100
18BEME551	Essence of Indian Traditional Knowledge	-	-	1	0	0	-	100	-	100
18BEME552	Geometrical Dimensioning and Tolerance	1	1,2,3,4,5,8,9	1	0	0	-	100	-	100
18BEME553A / 18BEME553B	Welding Application Technology / Repair Welding and Reclamation	-	-	2	0	0	-	100	-	100
18BEME554	Welding Process Laboratory	-	-	0	0	3	-	100	-	100
18BEME555	Project I (Course Oriented)	-	-	1	0	0	1	100	-	100
			Total	20	3	9	22	700	300	1000

SEMESTER VI										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME601	Design of Transmission Systems	1	1,2,3,4,8,9,10	3	1	0	4	40	60	100
18BEME641	Manufacturing Technology II	1	1,2,3,6,8,9	3	0	2	4	40	60	100
18BEME642	Industrial Metrology	1	1,2,3,6,8,9	3	0	2	4	40	60	100
18BEME6E	Professional Elective-I	-	-	3	0	0	3	40	60	100
18BEME6E	Professional Elective-II	-	-	3	0	0	3	40	60	100
18BE_____	Open Elective II	-	-	3	0	0	3	40	60	100
18BEME611	Computer Aided Modeling and Simulation Laboratory	1	1,2,3,4,5,8,9	0	0	3	2	40	60	100
18BEME651	Robotics and Automation	1	1,2,3,4,5	1	0	0	-	100	-	100
18BEME652A / 18BEME652B	Welding Codes and Standards / Welding Consumables	-	-	2	0	0	-	100	-	100
18BEME653	Heat Treatment Laboratory			0	0	3	-	100	-	100
18BEME654	Mini Project II on Welding			0	0	1	-	100	-	100
18BEME691	Project II (Mini)	-	-	1	0	0	1	100	-	100
			Total	22	1	11	24	780	420	1200

SEMESTER VII										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME741	Automation in Manufacturing	1	1,2,3,4,5,8,9	3	0	2	4	40	60	100
18BEME742	Computer Aided Engineering	1	1,2,3,4,5,8,9	3	1	2	5	40	60	100
18BEME7E	Professional Elective-III	-	-	3	0	0	3	40	60	100
18BEME7E	Professional Elective-IV	-	-	3	0	0	3	40	60	100
18BEME7E	Professional Elective-V	-	-	3	0	0	3	40	60	100
18BE_____	Open Elective III	-	-	3	0	0	3	40	60	100
18BEME751	Motors and Pumps	-	-	1	0	0	-	100	-	100
18BEME752A / 18BEME752B	Design Aspects of Welding & Casting / Design of Weldments	-	-	2	0	0	-	100	-	100
18BEME753	Welding Simulation Laboratory	-	-	0	0	3	-	100	-	100
18BEME754	Mini Project III on Welding	-	-	0	0	1	-	100	-	100
18BEME791	Project III	-	-	0	0	6	3	100	-	100
			Total	21	1	14	24	740	360	1100

SEMESTER VIII										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME8E	Professional Elective-VI	-	-	3	0	0	3	40	60	100
18BE_____	Open Elective IV	-	-	3	0	0	3	40	60	100
18BE_____	Open Elective V	-	-	3	0	0	3	40	60	100
18BEME891	Project IV	-	-	0	0	12	6	100	200	300
			Total	9	0	12	15	220	380	600

PROFESSIONAL ELECTIVE I

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME6E01	Emerging Materials	1,3	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E02	Renewable Energy Sources	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E03	Industrial Robotics	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEME6E04	Advanced I.C. Engines	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E05	Hydraulics and Pneumatics Power Control	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BEME6E06	Automobile Engineering	1	1,2,3,7,9,15	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE II

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME6E07	Design of Jigs, Fixtures and Press Tools	1,3	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E08	Refrigeration and Air Conditioning	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E09	Advanced Manufacturing Processes	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEME6E10	Vibration Analysis and Control	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME6E11	Design and Analysis of Experiments	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BEME6E12	Hybrid Vehicle Technology	1	1,2,3,7,9,15	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE III

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME7E01	Design for Manufacture and Assembly	1,3	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME7E02	Computational Fluid Dynamics	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME7E03	Power Plant Engineering	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEME7E04	Energy Conservation Methods and EnergyAudit	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEME7E05	Additive Manufacturing	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BEME7E06	Logistics & Supply Chain Management	1	1,2,3,7,9,15	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE IV

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME7E07	Gas Dynamics and Jet Propulsion	1,3	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E08	Design of Mechatronic Systems	1,2	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E09	Machine Tool Design	1	1,2,3,7, 13,15	3	0	0	3	40	60	100
18BEME7E10	Computer Integrated Manufacturing	1	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E11	Advanced Welding Technology	1,3	1,2,3,7, 9,12	3	0	0	3	40	60	100
18BEME7E12	Operation Research	1	1,2,3,7, 9,15	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE V

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME7E13	Manufacture and Inspection of Gears	1,3	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E14	Composite Materials	1,2	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E15	Design of HVAC Systems	1	1,2,3,7, 13,15	3	0	0	3	40	60	100
18BEME7E16	Non Destructive Testing	1	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME7E17	Industrial Safety Engineering	1,3	1,2,3,7, 9,12	3	0	0	3	40	60	100
18BEME7E18	Surface Engineering	1	1,2,3,7, 9,15	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE VI

Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEME8E01	Quality Control and Reliability Engineering	1,3	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME8E02	Production Planning and Control	1,2	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME8E03	Cogeneration and Waste Heat RecoverySystems	1	1,2,3,7, 13,15	3	0	0	3	40	60	100
18BEME8E04	Industrial Engineering	1	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEME8E05	Computer Aided Drafting and Cost Estimation	1,3	1,2,3,7, 9,12	3	0	0	3	40	60	100
18BEME8E06	Total Quality Management	1	1,2,3,7, 9,15	3	0	0	3	40	60	100

COURSES OFFERED BY OTHER DEPARTMENTS

SCIENCE & HUMANITIES										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BESHOE01	Probability and Random Process	1,3	1,2,3,7,9,13	3	0	0	3	40	60	100
18BESHOE02	Fuzzy Mathematics	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BESHOE03	Linear Algebra	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BESHOE04	Engineering Acoustics	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BESHOE05	Solid Waste Management	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BESHOE06	Green Chemistry	1	1,2,3,7,9,15	3	0	0	3	40	60	100
18BESHOE07	Applied Electrochemistry	1,2	2,3,4,5,13	3	0	0	3	40	60	100
18BESHOE08	Industrial Chemistry	1,2	2,3,4,5,14	3	0	0	3	40	60	100
18BESHOE09	Technical Writing	1	2,3,4,5,12	3	0	0	3	40	60	100
COMPUTER SCIENCE AND ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BECSOE01	Internet Programming	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BECSOE02	Multimedia and Animation	1	1,2,3,7,9,15	3	0	0	3	40	60	100
18BECSOE03	PC Hardware and Trouble shooting	1,2	2,3,4,5,13	3	0	0	3	40	60	100
18BECSOE04	Java Programming	1,2	2,3,4,5,14	3	0	0	3	40	60	100
ELECTRICAL AND ELECTRONICS ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEEEOE01	Electric Hybrid Vehicles	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEEEOE02	Energy Management & Energy Auditing	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEEEOE03	Programmable Logic Controller	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEEEOE04	Renewable Energy Resources	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
ELECTRONICS AND COMMUNICATION ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEECOE01	Real Time Embedded Systems	1,3	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEECOE02	Consumer Electronics	1,2	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEECOE03	Neural Networks and its Applications	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEECOE04	Fuzzy Logic and its Applications	1	1,2,3,7,9,13	3	0	0	3	40	60	100

BIOTECHNOLOGY										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BTBTOE01	Bioreactor Design	1	1,2,3,7,9,15	3	0	0	3	40	60	100
18BTBTOE02	Food Processing and Preservation	1,2	2,3,4,5,13	3	0	0	3	40	60	100
18BTBTOE03	Basic Bioinformatics	1,2	2,3,4,5,14	3	0	0	3	40	60	100
18BTBTOE04	Fundamentals of Nano Biotechnology	1	2,3,4,5,12	3	0	0	3	40	60	100
AUTOMOBILE ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEAEOE01	Automobile Engineering	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BEAEOE02	Two and Three Wheelers Technology	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BEAEOE03	Vehicle Maintenance	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BEAEOE04	Modern Vehicle Technology	1	1,2,3,7,9,15	3	0	0	3	40	60	100
18BEAEOE05	Fleet Management	1,2	2,3,4,5,13	3	0	0	3	40	60	100
CIVIL ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BECEOE01	Housing, Plan and Management	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BECEOE02	Building Services	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BECEOE03	Management of Irrigation Systems	1	2,3,4,5,12	3	0	0	3	40	60	100
18BECEOE04	Advanced Construction Technology	1	1,2,3,7,9,15	3	0	0	3	40	60	100
CHEMICAL ENGINEERING										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BTCEOE01	Energy Management in Chemical Industries	1	1,2,3,7,13,15	3	0	0	3	40	60	100
18BTCEOE02	Fertilizer Technology	1	1,2,3,7,9,13	3	0	0	3	40	60	100
18BTCEOE03	Industrial Wastewater Treatment	1,3	1,2,3,7,9,12	3	0	0	3	40	60	100
18BTCEOE04	Solid and Hazardous Waste Management	1	1,2,3,7,9,15	3	0	0	3	40	60	100

FOODTECHNOLOGY										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BTFTOE01	Processing of Food Materials	1	1,2,3,7, 13,15	3	0	0	3	40	60	100
18BTFTOE02	Nutrition and Dietetics	1	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BTFTOE03	Ready to Eat Foods	1,3	1,2,3,7, 9,12	3	0	0	3	40	60	100
18BTFTOE04	Agricultural Waste and Byproducts Utilization	1	1,2,3,7, 9,15	3	0	0	3	40	60	100
COURSES OFFERED TO OTHER DEPARTMENTS										
Course Code	Course title	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks		
		PEO	PO	L	T	P		CIA	ESE	Total
								40	60	100
18BEMEOE01	Computer Aided Design	1	1,2,3,7, 13,15	3	0	0	3	40	60	100
18BEMEOE02	Industrial Safety and Environment	1	1,2,3,7, 9,13	3	0	0	3	40	60	100
18BEMEOE03	Transport Phenomena	1	1,2,3,7, 9,14	3	0	0	3	40	60	100
18BEMEOE04	Introduction to Biomechanics	1	1,2,3,7, 9,15	3	0	0	3	40	60	100

Total number of credits: 171

PEO: ProgrammeEducationalObjectives **PO: ProgrammeOutcomes**
L: LectureHour **T: TutorialHour** **CIA: ContinuousInternal Assessment**
P:PracticalHour **C: No.ofCredits** **ESE: End Semester Examinations**

Note:

1. The passing minimum for Mandatory course is 50 marks out of 100 marks. There will be two tests, of which one will be class test covering 50% of syllabus for 50 marks and other for 50marks.
2. Credits for mandatory courses are not counted for computation ofCGPA.
3. A student will be eligible to get Under Graduate degree with Honors or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

Programme Educational Objectives (PEO's)

- **1:**Graduates will more conscious about their profession with social awareness and responsibility.
- **2:**Graduates will be engineering experts, who would help solve industry's technological problems.
- **3:**Graduates will be engineering professionals, consultants or entrepreneurs engaged in technology development.
- **4:**Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

Programme Outcomes (PO's)

- **1:** Ability to apply knowledge of mathematics and science in solving engineering problems.

- **2:** In-depth knowledge on the fundamental principles, construction and auxiliary systems of mechanical sciences.
- **3:** To understand the principles involved in evaluating the structural, functional and safety requirements of mechanical systems.
- **4:** Hands on knowledge to develop analytical skills for designing and analyzing various mechanical components and processes.
- **5:** To understand and apply appropriate techniques and IT tools for the design and analysis of mechanical systems.
- **6:** Understanding the mechanism of pollutant formation and its control techniques.
- **7:** Understanding of human and ethical responsibilities towards the profession and society.
- **8:** Ability to understand the economics and cost analysis in order to take economically sound decisions.
- **9:** Ability to apply modem techniques and tools necessary for engineering practice with appropriate considerations for public health, safety, cultural and environmental limitations.
- **10:** Understand the impact of engineering solutions in a societal context and to be able to respond effectively to the needs for sustainable development.
- **11:** Function effectively as an individual, and as a member or a leader in diverse teams, and in multi-disciplinary situations.
- **12:** To recognize the need for, and have the ability to engage in independent and lifelong learning.

ProgrammeSpecific Outcomes (PSO's)

- **13:** Ability to design a mechanical system, component, or process to meet desired needs of the nation, industries, institutions within realistic constraints such as economic, environmental, social, political, ethical, health care, and safety, manufacturability, and sustainability.
- **14:**Ability to develop and use of software tools and Information Technology for mechanical engineering domain.
- **15:**Ability to perform effectively first level managerial responsibilities for large or medium engineering organizations.

Programme Educational Objectives	Programme Objectives														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1			✓			✓	✓	✓	✓	✓			✓		
2	✓	✓	✓	✓	✓				✓					✓	
3	✓	✓	✓	✓	✓				✓		✓	✓		✓	
4								✓			✓				✓

SEMESTER I

18BEME101 **MATHEMATICSI** **4 H – 4 C**

(Calculus and LinearAlgebra for MechanicalandAutomobileEngineering)

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

The objective of this course is

1. To familiarize the prospective engineers with techniques in calculus, and multivariate analysis.
2. To familiarize the prospective engineers with techniques in linear algebra.
3. To equip the students with standard concepts and tools at an intermediate to advanced level.
4. To equip the students will serve them to wards tackling more advanced level of mathematics.
5. To make the students will serve them to find the useful applications in their disciplines.
6. To make the students to solve the real time problems using standard concepts and tools.

COURSE OUTCOMES

The students will learn:

1. To apply differential and integral calculus to notions of curvature and to improperintegrals.
2. Apart from some other applications they will have a basic understanding of Beta and Gammafunctions.
3. The tool of power series and Fourier series for learning advanced EngineeringMathematics.
4. To deal with functions of several variables that are essential in most branches ofengineering.
5. The essential tool of matrices and linear algebra in a comprehensivemanner.
6. Students can solve real time problems using standard concepts and tools.

UNITI MATRICES

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation. Simple problems using Scilab.

UNITII CALCULUS

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

UNITIII CALCULUS

Taylor’s and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

UNITIV MULTIVARIABLE CALCULUS(DIFFERENTIATION)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Maxima, minima and saddle points; Method of Lagrange multipliers;Gradient, curl and divergence.

UNITV SEQUENCES ANDSERIES

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval’stheorem

SUGGESTED READINGS

1. Hemamalini. P.T**,** (2014),Engineering Mathematics**,** McGraw Hill Education (India) Private Limited, New Delhi.
2. G.B. Thomas and R.L. Finney**,** (2002),Calculus and Analytic geometry, 9thEdition,Pearson**,**.
3. Erwin kreyszig**,** (2006),Advanced Engineering Mathematics, 9th Edition,John Wiley &Sons.
4. Veerarajan T**,** (2008),Engineering Mathematics for first year,Tata McGraw-Hill, NewDelhi,.
5. Ramana B.V**,** (2010),Higher Engineering Mathematics, 11th Reprint, Tata McGraw Hill NewDelhi.
6. D. Poole**,** (2005),Linear Algebra: A Modern Introduction, 2ndEdition,Brooks/Cole.
7. N.P. Bali and Manish Goyal, (2008), A text book of Engineering Mathematics, LaxmiPublications.
8. B.S. Grewal, (2010), Higher Engineering Mathematics, 36th Edition, KhannaPublishers

18BEME102 **ELECTROMAGENTISM** **7 H – 5.5 C**

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:3 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To introduce the basic physics concepts relevant to different branches of Engineering and Technology.
2. To acquire the knowledge of Electromagnetic field theory.
3. To make the student to learn scientific, mathematical and engineeringprinciples.
4. To make the students to understand the basics of vacuum science.
5. To make the students to understand the process of production and measurement.
6. To make the students to understand the working of Gauges like Pirani,McLeod and Penning

COURSE OUTCOMES

1. Formulate potential problems within electrostatics, magneto statics.
2. Formulate stationary current distributions in linear, isotropic media.
3. Acquire knowledge on properties of matter, quantum physics.
4. Understand the basics of vacuum science.
5. Understand the process of production and measurement.
6. Understand the working of Gauges like Pirani,McLeod and Penning.

UNITI ELECTROSTATICS INVACUUM

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect. **Electrostatics in a linear dielectric medium:** Polarization-Field of a polarized object-Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement.

UNITII MAGNETOSTATICS

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem. **Magnetostatics in a linear magnetic medium:** Magnetization-diamagnets, paramagnets, ferromagnets- Field of a magnetized object- bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and - $\vec{H}$ magnetic susceptibility and permeability - Ferromagnetism.

UNITIII PROPERTIES OFMATTER

Elasticity –Three types of modulus of elasticity – basic definitions, relation connecting the moduli (Derivation)-factors affecting elastic modulus and tensile strength–Poisson's ratio- Torsional pendulum-bending of beams - bending moment – uniform and non-uniform bending - I-shaped girders - stress due to bending in beams.

UNITIV QUANTUM MECHANICS

Introduction to quantum theory – Black body radiation - dual nature of matter and radiation – de Broglie wavelength, uncertainty principle –Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, scanning electron microscope.

UNITV VACUUM SCIENCE

Introduction - Importance of vacuum in industries - Pumping speed and throughput - Types of pumps-Rotary vane type Vacuum pump(oil sealed), Diffusion Pump and Turbo Molecular Pump - Measurement of High Vacuum-McLeod Gauge-Pirani Gauge-Penning Gauge.

SUGGESTED READINGS

1. David Griffiths, (2017),Introductionto Electrodynamics, Cambridgepublisher.
2. Ganesan.S and Baskar.T, (2015),Engineering Physics I, GEMS Publisher, Coimbatore-641001.
3. Ganesan S. IyanduraiN , (2007),Applied Physics, KKSPublishers.
4. Gaur, R.K. and Gupta, S.C, (2012),Engineering Physics, Dhanpat RaiPublications.
5. Halliday and Resnick, (2007), Physics, Wiley (5^{th}edition).
6. W. Saslow, (2002),Electricity, magnetism and light, AcademicPress.

(ii) Laboratory

COURSE OBJECTIVES

1. To learn the basic concepts in physics relevant to different branches of Engineering andTechnology.
2. To study the concept of semiconductor andconductivity.
3. To learn the properties ofmaterials.
4. To learn the basic concept of Numerical Aperture and acceptanceangle.
5. To make the students to determination of wavelength usinggrating.
6. To learn the basic concept about viscosity of liquids.

COURSE OUTCOMES

1. Understand the basic concepts in physics relevant to different branches of Engineering andTechnology.
2. Understand the concept of semiconductor andconductivity.
3. Acquire knowledge on the properties ofmaterials.
4. Understand the basic concept of Numerical Aperture and acceptanceangle.
5. Understand the students to determination of wavelength usinggrating.
6. Acquire knowledge on the basic concept about viscosity of liquids.

LIST OF EXPERIMENTS – PHYSICS

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia ofdisc
2. Non-uniform bending - Determination of young'smodulus
3. Uniform bending – Determination of young'smodulus
4. Lee's disc Determination of thermal conductivity of a badconductor
5. Potentiometer-Determination of thermo e.m.f of athermocouple
6. Laser- Determination of the wave length of the laser usinggrating
7. Air wedge - Determination of thickness of a thinsheet/wire
8. Optical fibre -Determination of Numerical Aperture and acceptanceangle
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility ofliquids
10. Determination of Band gap of asemiconductor.
11. Spectrometer- Determination of wavelength usinggrating.
12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille'sflow

18BEME103 BASIC ELECTRICALENGINEERING 6 H – 5 C

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To impart the basic knowledge about the Electriccircuits.
2. To understand the working of Electrical Machines andTransformers.
3. To understand the working of Power Converters and components of low-voltage electricalinstallations.
4. To understand and analyze basic electric and magnetic circuits.
5. To study the working principles of electrical machines and power converters.
6. To introduce the components of low-voltage electrical installations.

COURSE OUTCOMES

1. Gain the basic knowledge about the Electriccircuits.
2. Understand the working of Electrical Machines andTransformers.
3. Understand the working of Power Converters and components of low-voltage electricalinstallations
4. Understand and analyze basic electric and magneticcircuits.
5. Acquire knowledge on the working principles of electrical machines and powerconverters.
6. Understand the components of low-voltage electricalinstallations.

UNITI DCCIRCUITS

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation.Superposition, Thevenin and Norton Theorems.Time-domain analysis of first-order RL and RC circuits.

UNITII ACCIRCUITS

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNITIII ELECTRICAL MACHINES

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNITIV TRANSFORMERS AND POWER CONVERTERS

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer and three-phase transformer connections. Overviews of DC-DC buck and boost converters, duty ratio control. Introduction to Single-phase and three-phase voltage source inverters.

UNIT V ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

SUGGESTED READINGS

1. D. P. Kothari and I. J. Nagrath, (2010),Basic Electrical Engineering, Tata McGrawHill.
2. D. C. Kulshreshtha, (2009), Basic Electrical Engineering, McGrawHill.
3. L. S. Bobrow, (2011),Fundamentals of Electrical Engineering, Oxford UniversityPress.
4. E. Hughes, (2010), Electrical and Electronics Technology,Pearson.
5. V. D. Toro,(1989), Electrical Engineering Fundamentals, Prentice HallIndia.

(ii) Laboratory

COURSEOBJECTIVES

1. To impart the basic knowledge about the Electriccircuits.
2. To understand the working of Electrical Machines andTransformers.
3. To understand the working of Power Converters and components of low-voltage electrical installations.
4. To understand and analyze basic electric and magnetic circuits.
5. To study the working principles of electrical machines and power converters.
6. To introduce the components of low-voltage electrical installations.

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability
1. Gain the basic knowledge about the Electriccircuits.
2. Understand the working of Electrical Machines andTransformers.
3. Understand the working of Power Converters and components of low-voltage electricalinstallations
4. Understand and analyze basic electric and magneticcircuits.
5. Acquire knowledge on the working principles of electrical machines and powerconverters.
6. Understand the components of low-voltage electricalinstallations.

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law and Kirchoff'slaw.
2. Measurement of electrical quantities – voltage, current, power & power factor in Rload.
3. Speed control of DC shuntmotor
4. Draw the equivalent circuit of single-phase Transformer by conducting OC &SCTest.
5. Measurement of energy using single phase energymeter.

SUGGESTED READING

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill,2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press,2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson,2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India,1989

18BEME111 ENGINEERINGGRAPHICSI 5 H – 3 C

Instruction hours / week L : 1 T : 0 P:4 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the students to design a system, component, or process to meet desired needs.
2. To prepare the students to design the components with realistic constraints.
3. To make the students to consider economic, environmental, ethical, health and safety when they design.
4. To make the students to design the components with considering manufacturability, andsustainability
5. To prepare the students to communicate effectively using the techniques, skills, and modern engineering tools.
6. To make the students to understand to use necessary for engineeringpractice.

COURSE OUTCOMES

The student will alsolearn:

1. Introduction to engineering design and its place insociety
2. Exposure to the visual aspects of engineering design and engineering graphicsstandards
3. Exposure to engineeringcommunication effectively.
4. Exposure to 3D free hand sketching.
5. Acquired the knowledge of projections of points, lines and plane surfaces.
6. Understand the basic concept of projection of solids.

UNITI INTRODUCTION

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension.

UNITII SCALES AND PLANECURVES

SCALES: Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute.

UNITIII FREE HANDSKETCHING

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection –Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNITIV PROJECTION OF POINTS, LINES AND PLANESURFACES

Projection of points and straight lines located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations–Projection of polygonal surface and circular lamina inclined to both reference planes.

UNITV PROJECTION OFSOLIDS

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

SUGGESTED READINGS

1. Venugopal K and Prabhu Raja V, (2010), Engineering Graphics, New Age InternationalPublishers.
2. C M Agrawal and Basant Agrawal, (2012),Engineering Graphics, Tata McGraw Hill, NewDelhi.
3. James D. Bethune, (2015), Engineering Graphics with AutoCAD , PearsonEducation.
4. Narayana, K.L. & P Kannaiah, (2008), Text book on Engineering Drawing, ScitechPublishers.
5. Bureau of Indian Standards, (2003), Engineering Drawing Practices for Schools and Colleges SP 46, (2003), BIS, NewDelhi.
6. Shah, M.B. & Rana B.C., (2008), Engineering Drawing and Computer Graphics, PearsonEducation,.
7. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar PublishingHouse.

SEMESTER II

18BEME201 **MATHEMATICS -II** **6 H – 5 C**

(Calculus, OrdinaryDifferential Equations and Complex variable forMechanical and Automobile Engineering**)**

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To familiarize the prospective engineers with techniques in Multivariate integration.
2. To familiarize the concept of ordinary and partial differential equations and complex variables.
3. To equip the students to deal with advanced level of mathematics and applications.
4. To make the students to formulate and solve problems involving random variables.
5. To equip the students to Understand the basic concepts of one- and two-dimensional random variables.
6. To understand the concept of testing of hypothesis for small and large samples in real life problems.

COURSE OUTCOMES

1. The mathematical tools needed in evaluating multiple integrals and theirusage.
2. The effective mathematical tools for the solutions of differential equations that model physicalprocesses.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineeringProblems.
4. Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.
5. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data
6. Apply the concept of testing of hypothesis for small and large samples in real life problems.

UNIT I Multivariable Calculus (Integration)

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Applications: areas and volumes, Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, Simple applications involving cubes and rectangular parallelepipeds.

UNIT II First order ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut'stype.

UNIT III Ordinary differential equations of higher orders

Second order linear differential equations with variable coefficients, method of variation ofparameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Besselfunctions of the first kind and their properties.

UNITIV Analytic Functions

Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)and their properties; Conformal mappings, Mobius transformations.

UNITV Complex Integration

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula(without proof), zeros of analytic functions, singularities, Taylor's series, Laurent's series, Residues, CauchyResidue theorem (without proof), Evaluation of definite integral involving sine and cosine.

SUGGESTED READINGS

1. Hemamalini. P.T., (2014), Engineering Mathematics, McGraw Hill Education (India) Private Limited,, NewDelhi.
2. G.B. Thomas and R.L. Finney, (2002), Calculus and Analytic geometry, 9th Edition,Pearson.
3. Erwin kreyszig, (2006), Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons.
4. W.E.BoyceandR. C.DiPrima,(2009),ElementaryDifferentialEquationsandBoundary,ValueProblems9thEdn., WileyIndia.
5. S. L. Ross,(1984), Differential Equations, 3rd Ed., WileyIndia.
6. E. A. Coddington, (1995),An Introduction to Ordinary Differential Equations, Prentice Hall,India.
7. E. L. Ince, (1958),Ordinary Differential Equations, DoverPublications.
8. J. W. Brown and R. V. Churchill,(2004), Complex Variables and Applications, 7th Ed., Mc-GrawHill.
9. N.P. Bali and Manish Goyal, (2008),AText book of Engineering Mathematics, LaxmiPublications.
10. B.S. Grewal, (2010), Higher Engineering Mathematics, 36th Edition, KhannaPublishers.

18BEME202 CHEMISTRY -I 7 H – 5.5 C

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:3 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Concepts in chemistry forengineering

COURSEOBJECTIVES

1. To understand the terminologies of atomic and molecularstructure
2. To study the basics of Periodic properties, Intermolecularforces
3. To study about spectroscopictechnique
4. To understand the working of electromagnetic spectrum and spectroscopictechniques
5. To understand the thermodynamicfunctions
6. To comprehend the basic organic chemistry and to synthesis simpledrug.

COURSEOUTCOMES

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecularforces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states andelectronegativity.
3. Understand the ranges of the electromagnetic spectrum used for exciting different molecular energy levels.
4. Understand the concept of various spectroscopictechniques.
5. Rationalise bulk properties and processes using thermodynamicconsiderations.
6. List major chemical reactions that are used in the synthesis ofmolecules.

UNIT I Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity.Introduction to Crystal field theory.

UNIT II Periodic properties, Intermolecular forces and potential energy surfaces

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.Equations of state of real gases and critical phenomena. Potential energy surfaces of H_2F and HCN and trajectories on these surfaces.

UNIT III Spectroscopic techniques and applications

Spectroscopy (Principles and Instrumentation only).Electronicspectroscopy.Vibrational and rotational spectroscopy.Applications.Surface characterization techniques.Diffraction and scattering.Fluorescence and its applications in medicine.

UNIT IV Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.Acid base, oxidation reduction and solubility equilibria.Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT V Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings.Synthesis of a commonly used drugmolecule.

SUGGESTED READINGS

1. B. H. Mahan, (2010), University chemistry, PearsonEducation.
2. M. J. Sienko and R. A. Plane, Chemistry: Principles andApplications.
3. C. N. Banwell, (1994), Fundamentals of Molecular Spectroscopy,McGraw-Hill.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTELWeb-book)
5. P. W. Atkins, (2009), Physical Chemistry, Oxford UniversityPress.
6. K. P. C. Volhardt and N. E. Schore, (2014), 5th Edition, Organic Chemistry: Structure and Function,W.H. Freeman.
7. P C Jain & Monica Jain, (2015), Engineering Chemistry, Dhanpat Rai PublishingCompany.

(i) ChemistryLaboratory

COURSEOBJECTIVES

1. To understand the terminologies of atomic and molecularstructure
2. To study the basics of Periodic properties, Intermolecularforces
3. To study about spectroscopictechnique
4. To understand the working of electromagnetic spectrum and spectroscopictechniques
5. To understand the thermodynamicfunctions
6. To comprehend the basic organic chemistry and to synthesis simpledrug.

COURSEOUTCOMES

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecularforces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states andelectronegativity.
3. Understand the ranges of the electromagnetic spectrum used for exciting different molecular energy levels.
4. Understand the concept of various spectroscopictechniques.
5. Rationalise bulk properties and processes using thermodynamicconsiderations.
6. List major chemical reactions that are used in the synthesis ofmolecules.

Choice of 10 experiments from the following:

Determination of surface tension and viscosity

1. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
2. Determination of Ca / Mg using complexometrictitration
3. Thin layer chromatography
4. Determination of chloride content ofwater
5. Determination of the rate constant of areaction
6. Conductometry - Determination of cell constant and conductance ofsolutions
7. pH Metry – Determination of Acid /Base
8. Potentiometry - determination of redox potentials andemfs
9. Saponification/acid value of anoil
10. Determination of the partition coefficient of a substance between two immiscibleliquids
11. Adsorption of acetic acid bycharcoal
12. Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimumviscosity for gelatin sols and/or coagulation of the white part ofegg.

18BEME203 ENGLISH 4 H – 3 C

Instruction hours / week L : 2 T : 0 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To enable students to attain fluency and accuracy to inculcate proficiency in professionalcommunication.
2. To make the students to meet the growing demand in the field of Globalcommunication.
3. To help students acquire their ability to speak effectively in real lifesituations.
4. To inculcate the habit of reading and to develop their effective readingskills.
5. To ensure that students use dictionary to improve their active and passivevocabulary.
6. To enable students to improve their lexical, grammatical and communicativecompetence.

COURSE OUTCOMES

1. Use English language for communication: verbal & non –verbal.
2. Enrich comprehension and acquisition of speaking & writingability.
3. Ensure students proficiency in professionalcommunication.
4. Developed their active and passivevocabulary.
5. Gain confidence in using English language in real lifesituations.
6. Improve word power: lexical, grammatical and communication competence.

UNITI BASIC WRITINGSKILLS

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

UNITII VOCABULARYBUILDING

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

UNITIII GRAMMAR ANDUSAGE

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

UNITIV LISTENING AND READINGSKILLS

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

UNITV WRITINGPRACTICES

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

1. Sangeeta Sharma , Meenakshi Raman, (2015),Technical Communication: Principles And Practice, 2nd Edition, OUP, NewDelhi.
2. Sanjay Kumar and PushpLata, (2011),Communication Skills ,Oxford UniversityPress.
3. Liz Hamp - Lyons and Ben Heasly, (2006), Study Writing, Cambridge UniversityPress.
4. F.T. Wood., (2007),Remedial English Grammar,Macmilla.
5. Michael Swan, (1995),Practical English Usage,OUP.

18BEME204 PROGRAMMING FOR PROBLEMSOLVING 7 H – 5 C
(Theory & Lab)

Instruction hours / week L : 3 T : 0 P:4 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

(i) Theory

COURSEOBJECTIVES

1. Identify and understand the working of key components of a computerprogram.
2. Identify and understand the various kinds of keywords and different data types of Cprogramming
3. Understand, analyze and implement software development tools likealgorithm,
4. pseudo codes and programmingstructure
5. Study, analyze and understand logical structure of a computer program, and different construct to develop a program in "C"language
6. Programming to solve matrix addition and multiplication problems and searching and sorting problems.

COURSE OUTCOMES

1. To formulate simple algorithms for arithmetic and logicalproblems
2. To translate the algorithms to programs (in C language)
3. To test and execute the programs and correct syntax and logicalerrors
4. To implement conditional branching, iteration andrecursion
5. To decompose a problem into functions and synthesize a complete program using divide and conquerapproach
6. To use arrays, pointers and structures to formulate algorithms andprograms

UNITI INTRODUCTIONTOPROGRAMMING,ARITHMETICEXPRESSIONS ANDPRECEDENCE

Introduction to Programming-Flowchart / pseudocode, compilation, Variables including data types, Arithmetic expressions and precedence.

UNITII CONDITIONAL BRANCHING ANDLOOPS

Conditional Branching – Loops Writingand evaluation of conditionals and consequent branching, Iteration and loops.

UNITIII ARRAYS AND BASICALGORITHMS

Arrays1-D,2-D,CharacterarraysandStrings**Basic Algorithms**: Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity.

UNITIV FUNCTION ANDRECURSION

Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.

UNITV STRUCTURE, POINTERS AND FILEHANDLING

Pointers, Structures including self-referential structures e.g., linked list, notional introduction, File handling in C.

SUGGESTED READINGS

1. E. Balagurusamy,(2017) Computing Fundamentals and C Programming, 5th Edition, TMHEducation
2. E. Balaguruswamy (2017), Programming in ANSI C, 7th Edition, TataMcGraw-Hill,
3. Byron Gottfried (2017), Schaum's Outline of Programming with C, 3rd Edition,McGraw-Hill
4. Brian W. Kernighan and Dennis M. Ritchie,(2015) The C Programming Language, 2nd Edition,Prentice Hall of India

(ii) Laboratory

COURSE OBJECTIVES

1. To provide an awareness to Computing and CProgramming
2. To know the correct and efficient ways of solvingproblems
3. To learn to develop algorithm for simple problemsolving.
4. To Study, analyze and understand logical structure of a computer program
5. To be able to declare pointers of different types and use the mind defining self- referential structures.
6. To be able to create, read and write to and from simple textfiles.

COURSE OUTCOMES

1. To formulate the algorithms for simpleproblems
2. To translate given algorithms to a working and correctprogram
3. To be able to correct syntax errors as reported by thecompilers
4. To be able to identify and correct logical errors encountered at runtime
5. To be able to write iterative as well as recursiveprograms
6. To be able to represent data in arrays, strings and structures and manipulate them through a program

List of Experiments

Tutorial1 **:** Problem solving usingcomputers:
Lab1 **:** Familiarization with programmingenvironment
Tutorial2 **:** Variable types and typeconversions:
Lab 2 **:** Simple computational problems using arithmeticexpressions
Tutorial3 **:** Branching and logicalexpressions:
Lab 3 **:** Problems involving if-then-elsestructures
Tutorial4 **:** Loops, while and forloops:
Lab4 **:** Iterative problems e.g., sum ofseries
Tutorial5 **:**1DArrays: searching,sorting:
Lab 5 **:**1DArraymanipulation
Tutorial6 **:**2D arrays and Strings, memorystructure:
Lab6 **:** Matrix problems, Stringoperations
Tutorial7 **:** Functions, call byvalue:
Lab 7 **:** Simplefunctions
Tutorial 8& 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8and 9 : Numericalmethods problems
Tutorial 10 : Recursion, structure of recursive calls:
Lab 10 **:** Recursivefunctions
Tutorial 11 : Pointers, structures and dynamic memory allocation
Lab 11 **:** Pointers andstructures
Tutorial 12 : File handling:
Lab 12 **:** Fileoperations

18BEME205 CONSTITUTIONOFINDIA 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam:3Hours

COURSE OBJECTIVES

1. To know about Indianconstitution.
2. To know about central government functionalities inIndia.
3. To know about state government functionalities inTN.
4. To know the relations between central and state government.
5. To know about Right of Women and Children.
6. To know about Indiansociety.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

1. Understand the functions of the Indiangovernment.
2. Understand the functions of the stategovernment.
3. Understand the relations between central and state government.
4. Understand and abide the rules of the Indianconstitution.
5. Understand and appreciate different culture among thepeople.
6. Understand the Rights of Women, Children and other Weaker Sections.

UNITI INTRODUCTION

HistoricalBackground–ConstituentAssemblyofIndia–PhilosophicalfoundationsoftheIndianConstitution –Preamble–FundamentalRights–DirectivePrinciplesofStatePolicy–FundamentalDuties–Citizenship– Constitutional Remedies for citizens.

UNITII STRUCTURE AND FUNCTION OF CENTRALGOVERNMENT

Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNITIII STRUCTURE AND FUNCTION OF STATEGOVERNMENT

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – StateLegislature – Judicial System in States – High Courts and other Subordinate Courts.

UNITIV CONSTITUTIONFUNCTIONS

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNITV INDIANSOCIETY

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India;Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women,Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

SUGGESTED READINGS

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, NewDelhi
2. R.C.Agarwal, (1997).Indian Political System ,S.Chand and Company, NewDelhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, NewDelhi
4. K.L.Sharma(1997)., Social Stratification in India: Issues and Themes , Jawaharlal Nehru University, New Delhi,
5. Sharma, Brij Kishore,(2011)., Introduction to the Constitution of India, Prentice Hall of India, NewDelhi,
6. U.R.Gahai, (1998).Indian Political System, New Academic Publishing House, NewDelhi,.
7. R.N. Sharma, (1987).Indian Social Problems, Media Promoters and Publishers Pvt. Ltd, NewDelhi,

18BEME211 WORKSHOP /MANUFACTURINGPRACTICE 4 H – 2 C

Instruction hours / week L : 0 T : 0 P:4 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To prepare the students to design a system, component, or process.
2. To meet desired needs within realistic constraints such as economic, environmental, social, and ethical.
3. To make the component with health and safety, manufacturability, andsustainability
4. To prepare the students to communicate effectively and to use the techniques, and skills.
5. To make the students to use modern engineering tools necessary for engineeringpractice.
6. To make the students to assemble different components.

COURSE OUTCOMES

Upon completion of this course,

1. The students will gain knowledge of the different manufacturing processes.
2. To fabricate components using differentmaterials.
3. Students will be able to fabricate components with their ownhands.
4. They will also get practical knowledge of the dimensional accuracies and dimensionaltolerances
5. By assembling different components with different processes.
6. They will be able to produce small devices of theirinterest.

(i) Lectures & videos: (10 PERIODS)

Detailedcontents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1lecture)**
3. Fitting operations & power tools **(1lecture)**
4. Electrical &Electronics **(1lecture)**
5. Carpentry **(1lecture)**
6. Plastic moulding, glass cutting **(1lecture)**
7. Metal casting **(1lecture)**
8. Welding (arc welding & gas welding), brazing **(1lecture)**

(ii) Workshop Practice: (60PERIODS)

1. Machine shop **(10Periods)**
2. Fitting shop **(8Periods)**
3. Carpentry **(6Periods)**
4. Electrical &Electronics**(8Periods)**
5. Welding shop **(8 hours (Arc welding 4 Periods + gas welding 4Periods)**
6. Casting **(8Periods)**
7. Smithy **(6Periods)**
8. Plastic moulding& Glass Cutting **(3Periods)**
9. Plumbing Exercises **(3 Periods)**

SUGGESTED READINGS

1. Jeyachandran, K. and Balasubramanian, S, (2007), A Premier on Engineering Practices Laboratory, Anuradha Publications,Kumbakonam.
2. Jeyapoovan, T., Saravanapandian, M, (2006), Engineering Practices Lab Manual, Vikas Puplishing House Pvt. Ltd,Chennai.
3. Bawa, H.S, (2007),Workshop Practice, Tata McGraw – Hill Publishing Company Limited, NewDelhi.
4. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K, (2008&2010))Elements of Workshop Technology", Vol. I and Vol. II, Media promoters and publishers privatelimited.
5. Gowri P. Hariharan and A. Suresh Babu, (2008), Manufacturing Technology – I, PearsonEducation.
6. Kalpakjian S. And Steven S. Schmid, (2002), Manufacturing Engineering and Technology, Pearson Education IndiaEdition.
7. Roy A. Lindberg, (1998) ,Processes and Materials of Manufacture, Prentice HallIndia.
8. Rao P.N., (2017), Manufacturing Technology, Vol. I and Vol. II, Tata McGrawHillHouse.

18BEME212 ENGINEERING GRAPHICS-II 4 H – 2.5 C

Instruction hours / week L : 1 T : 0 P:3 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To prepare the students to make section of solids like Prism, Cylinder, and Pyramid.
2. To prepare true shape of section.
3. To gain the knowledge on lateral surfaces.
4. To acquire the knowledge about development of surfaces like Prisms, pyramids, cylinders and cones.
5. To gain the knowledge on 2D drawing using CAD software.
6. To acquire the knowledge on basics of 3D modeling packages.

COURSE OUTCOMES

1. The students to draw section of solids like Prism, Cylinder, and Pyramid.
2. Students can prepare true shape of section.
3. Students gain the knowledge on lateral surfaces.
4. Students acquire the knowledge about development of surfaces like Prisms, pyramids, cylinders and cones.
5. Students gain the knowledge on 2D drawing using CAD software.
6. Students acquire the knowledge on basics of 3D modeling packages.

UNITI - SECTION OF SOLIDS

Sectioning of Prism, Cylinder, Pyramid, and Conein simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

UNITII - DEVELOPMENT OFSURFACES

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNITIII- ISOMETRIC PROJECTIONS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

UNITIV- COMPUTER GRAPHICS –2D

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars, Drawing Area, Dialog boxes and windows, Shortcut menus ,The Command Line (where applicable), Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids; consisting of set up of the drawing page and the printer, including scale settings, Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Annotations, layering & other functions, Demonstration of a simple team design project, Introduction to Building Information Modeling

UNITV- COMPUTER GRAPHICS –3D

Introduction to3D modeling packages. Drafting practices - modeling of simple engineering components, sections and extraction of 2D drawings.

SUGGESTED READINGS:

1. Venugopal K and Prabhu Raja V, (2010),Engineering Graphics, New Age InternationalPublishers.
2. C M Agrawal and Basant Agrawal, (2012),Engineering Graphics, Tata McGraw Hill, NewDelhi.
3. James D. Bethune, (2015), Engineering Graphics with AutoCAD , PearsonEducation.
4. Narayana, K.L. & P Kannaiah, (2008), A Text book on Engineering Drawing, ScitechPublishers.
5. Bureau of Indian Standards, (2003), Engineering Drawing Practices for Schools and Colleges SP 46, BIS, New Delhi.
6. Shah, M.B. & Rana B.C. , (2008),Engineering Drawing and Computer Graphics, PearsonEducation.
7. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar PublishingHouse.

SEMESTER – III

18BEME301 MATHEMATICSIII 4 H – 4 C

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam:3Hours

COURSE OBJECTIVES

1. To introduce the basic concepts of PDE for solving standard partial differentialequations
2. To acquaint the student with Fourier series techniques in solving heat flow problems used in varioussituations.
3. To provide an overview of probability and statistics toengineers
4. To introduce the basic concepts of two-dimensional randomvariables
5. To acquaint the knowledge of testing of hypothesis for small and large samples.
6. To apply testing of hypothesis in important role in real lifeproblems.

COURSE OUTCOMES

After successfully completing the course, the student will have a good understanding of the following topics and their applications

1. Thefundamentalconceptsofpartialdifferentialequationsandthevarioussolutionproceduresforsolvingthefirst order non-linear partial differentialequations.
2. Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional waveequations.
3. Understand the basic concepts of one knowledge of the concepts of probability and have knowledge of standard distribution which can describe real life phenomenon.
4. Understand the basic concepts of one- and two-dimensional random variables and apply in engineeringapplications.
5. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimentaldata
6. Apply the concept of testing of hypothesis for small and large samples in real lifeproblems.

UNIT I PARTIAL DIFFERENTIALEQUATIONS

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of PDE – Method of separation of variables – Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.

UNIT III PROBABILITY AND RANDOMVARIABLES

Probability – Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moment generating functions – Binomial, Poisson and Normal distributions.

UNITIV TWO – DIMENSIONAL RANDOMVARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNITV TESTING OFHYPOTHESIS

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means. Test for ratio of variances - Chi-square test for goodness of fit and independence ofattributes.

TEXTBOOKS/REFERENCES:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. Grewal B.S., "Higher Engineering Mathematics", 43rdEdition, Khanna Publishers, New Delhi,2014.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
6. S. Ross, A First Course in Probability, 6thEd., Pearson Education India,2002.

18BEME302 BIOLOGYFORENGINEERS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the basics ofbiology
2. To gain knowledge about differentbiomolecules
3. To get familiarize with humandiseases.
4. To learn about DNA & RNA.
5. To learn about different clinicalinvestigations
6. To know the recent advances inbiology

COURSE OUTCOMES

At the end of the course

1. Summarize the cell structures and itsfunctions
2. Explain the Biomoleculesfunctions
3. Classify the communicable and non-communicable humandiseases
4. Illustrate the different organ functiontests
5. Tell the applications of biology in environmentalapplications
6. Describe the concept ofbiomechanics

UNIT I - BASICS OF BIOLOGY

Cell structure: Prokaryotic and eukaryotic cells, AnimalandPlantCell, Cell cycle – Mitosis - Meiosis,

UNIT II - BIOMOLECULES

Nucleic acid – DNA – Structure - types, RNA – Structure – types, Proteins – classification, biological functions, carbohydrates - classification, biological functions, lipids – classification, biological functions, Hormones-definition, importance;Vitamins.

UNIT III – HUMAN DISEASES

Communicable diseases –Tuberculosis, Chikungunya, Dengue, Influenza, HIV/AIDS; Non-Communicable diseases – Diabetes, Cancer, Cardiovascular diseases.

UNIT IV – ORGAN FUNCTION TESTS

Liver function tests – Functions of liver- Tests to assess liver function- Bilirubin related liver test; Renal function tests – Tests to assess renal function - Clearance test – Creatine and urea- Urine concentration test; Gastric function tests – Tests to assess gastric function - Fractional test meal, Alcohol test meal, Insulin test meal; Pancreatic Function Test –Secretin test, Lundh test.

UNIT V – APPLICATIONS OF BIOLOGY

Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for environmental applications; Biosensors; Biofuel- Biogas, Biodiesel; Biomechanics – Biofluid mechanics, Biotribology.

SUGGESTED READINGS:

1. R.C.Dubey, S. Chand. (2013). A Text book of Biotechnology, Higher AcademicPublications.
2. Arthur T. Johnson. (2016). Biology for Engineers, CRC Press, Taylor andFrancis.
3. Satyanaraynaa. (2017). Biochemistry, 5th edition. Books and allied PVTLtd.
4. Carol D. Tamparo and Marcia A. Lewis, F.A. (2011) Diseases of the Human Body, DavisCompany.
5. Satyanaraynaa. (2016). Biotechnology, Books and allied PVTLtd.
6. Duane Knudson. (2007). Fundamentals of Biomechanics, 2nd Edition,Springer.

18BEME303 ENGINEERINGMECHANICS 4 H – 4 C

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To develop capacity to predict the effect of force and motion.
2. To understand the importance of free body diagram for complex machine structure.
3. To perform force analysis using law of mechanics.
4. To introduce the concepts of static equilibrium condition for particles and rigid bodies
5. To Understand the concepts of kinematics of particles and friction.
6. To make the students conversant to solve the problems using equation of motions.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basic concepts of force and laws of mechanics.
2. Develop free body diagram for complex machine structure and to perform force analysis.
3. Apply static equilibrium condition for particles and rigid bodies.
4. Locate the center of gravity and moment of inertia for planes and solids.
5. Understand the concepts of kinematics of particles and friction.
6. Solve the problems using equation of motions.

UNITI STATICS OFPARTICLES

Forces – system of forces – concurrent forces in plane and space– resultant – problems involving the equilibrium of a particle–free body diagram–equilibrium of particle in space.

UNITII STATICS OF RIGID BODIES IN TWODIMENSIONS

Rigid bodies–moment of force about an axis–moments and couples–equivalent system of coplanar forces–Rigid body in equilibrium–problems involving equilibrium of rigid body–types of supports–reactions of beams.

UNITIII CENTROID, CENTRE OF GRAVITY AND MOMENT OFINERTIA

Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia – radius of gyration – mass moment of inertia of simple solids.

UNITIV KINEMATICS OFPARTICLES

Introduction – plane, rectilinear motion – time dependent motion – rectangular coordinates – projectile motion.

IMPULSE AND MOMENTUM: Concept of conservation of momentum – Impulse–Momentum principle–Impact – Direct central impact – Oblique central impact.

UNIT V KINETICS OF PARTICLES AND FRICTION

KINETICS OF PARTICLES: Equations of motion–rectilinear motion–Newton's II law – D'Alembert's principle – Energy – potential energy–kinetic energy–conservation of energy–work done by a force.

Laws of friction – coefficient of friction–problems involving dry friction – wedge and ladder friction.

SUGGESTED READINGS

1. Ferdinand P. Beer, J.R Russell Johnston, David F. Mazurek, S. Brian and Dr. Sanjeev Sanghi, Vector Mechanics for Engineers–Statics and Dynamics, 11th Edition, Tata Mc–Graw Hill Publishing Co. Ltd., New Delhi,2017
2. Rajasekaran.S and Sankarasubramanian G, Engineering Mechanics–Statics and Dynamics, 1st Edition, Vikas Publishing House Pvt. Ltd., New Delhi,2011.
3. Bansal R K, Engineering Mechanics, 4th edition, Laxmi Publications Pvt. Ltd., New Delhi,2016
4. Young D H and Timashenko S, Engineering Mechanics, 5th Edition, Tata McGraw–Hill, New Delhi,2013
5. N H Dubey, Engineering Mechanics: Statics and Dynamics, 1st Edition, Tata McGraw–Hill, New Delhi,2012.

18BEME304 **THERMODYNAMICS** **4 H – 4 C**

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the Model of physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
2. To provide knowledge on entropy change in thermodynamic processes.
3. To Study and acquire knowledge on various thermodynamic properties of pure substances in real time problems.
4. To establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. To facilitate the understanding of properties of air using psychometric chart.
6. To acquaint the student with the concepts and applications of the thermodynamics to the various real-life systems.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Model the physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
2. Determine entropy change in thermodynamic processes.
3. Identify the various thermodynamic properties of pure substances in real time problems.
4. Establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. Calculate the properties of air using psychometric chart.
6. Explain the basic principles and applications of the thermodynamics to the various real life systems.

UNIT I BASIC CONCEPTS AND FIRSTLAW

Basic concepts - Classical and Statistical approaches - Thermodynamic systems - closed, open, isolated. Property – State - Process-adiabatic - Quasi-static process – Cycle - Point and Path function – Energy - Work transfer - Concept of temperature and heat- Zeroth law of thermodynamics - Concept of ideal gases - First law of thermodynamics –PMM1, internal energy, specific heat capacities, enthalpy, and its application to closed system and open system-steady flow energyequation.

UNITII SECOND LAW ANDENTROPY

Physical description of the second law - Kelvin-Planck and Clausius statements –Equivalence - Reversible processes and cycles- Carnot cycle – Corollaries - Absolute temperature scale – Clausius Theorem, inequality - Entropy- Principle, transfer, generation, balance - Third law of thermodynamics

UNIT III THERMODYNAMIC AVAILABILITY ANDRELATIONS

Basics-Dead state, quality of energy, degradation of energy - Reversible processes – Maximum work - Exergy – Closed system - Steady flow system – Irreversibility - Exergy Balance - Second law efficiency – Exact differentials - Tds Relations - Maxwell's Relation – Clausius – Clapeyron Equation - Joule-Thompson Coefficient.

UNITIV PROPERTIES OF PURE SUBSTANCE AND GASMIXTURES

Pure substance - Phase change process - Property diagrams - PVT surface - Steam – types, dryness fraction - Avogadro's law - Ideal Gas - Equations of state-Vander Waal's equation - Real Gas - Compressibility and its chart - Mixtures of Gases – Properties.

UNITV PSYCHROMETRY

Psychrometry - Psychrometric charts - Property calculations of air vapour mixtures- Psychrometric process-Adiabatic mixing - Evaporative cooling.

(Permitted to use standard thermodynamic table, Mollier diagram, and Psychometric chart in the examination)

SUGGESTED READINGS

1. Nag P K, Engineering Thermodynamics, 6th Edition, Tata McGraw-Hill, New Delhi,2017
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics-An Engineering Approach, 8th Edition, Tata McGraw-Hill, New Delhi,2015
3. C P Arora, Thermodynamics, 12th Reprint, McGraw-Hill, NewDelhi,2007
4. Kothandaraman C P and Domkundwar S, A Course in Thermal Engineering, Dhanpat Rai & Company (P) Limited, New Delhi,2010

18BEME341 BASIC ELECTRONICSENGINEERING 5 H – 4 C

(Theory & Lab)

Instruction hours / week L : 3 T : 0 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To provide an overview of various analogdevice
2. To provide an overview of Digitalconcepts
3. To learn working of amplifier and its application.
4. To understand the concept of RC-timing circuits.
5. To learn cellular concept and block diagram of GSM system.
6. To provide a review of communicationsystem

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the principles of semiconductor devices and theirapplications.
2. Understand the concept of voltageregulators
3. Design an application using Operationalamplifier.
4. Understand the working of timing circuits andoscillators.
5. Understand logic gates, flip flop as a building block of digitalsystems.
6. Learn the basics of Electronic communicationsystem.

UNITI SEMICONDUCTOR DEVICES ANDAPPLICATIONS

Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

UNITII OPERATIONAL AMPLIFIER AND ITSAPPLICATIONS

Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

UNITIII TIMING CIRCUITS ANDOSCILLATORS

RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

UNITIV DIGITAL ELECTRONICSFUNDAMENTALS

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

UNITV ELECTRONIC COMMUNICATIONSYSTEMS

The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

SUGGESTED READINGS

1. Floyd ," Electronic Devices" Pearson Education 9th edition,2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition,2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition,2001

(ii) Laboratory

COURSE OBJECTIVES

1. To learn the characteristics of basic electronic devices such as Diode,BJT
2. To understand the basic operation and configuration of linear integratedcircuits.
3. To understand the basic operation of Integrator andDifferentiator.
4. To learn characteristics of basic electronic devices with variousconfigurations.
5. To understand the working of Multiplex and Demultiplexer using Logicgates.
6. To understand the basics of logic gates and other digitalcircuits.

COURSE OUTCOMES

On completion of this laboratory course, the student should be able to:

1. Design amplifiers, oscillators, D-A converters using operationalamplifier
2. Analyze the characteristics of basic electronic devices with variousconfigurations.
3. Design and Test the digital logiccircuits.
4. Design and Test sequentialcircuits
5. Construct multivibrators using555.
6. Understand the concept of Flipflop using Logicgates.

List of Experiments

1. Characteristics of PN JunctionDiode
2. Common Emitter input-outputCharacteristics
3. Inverting, Non inverting and differentialamplifiers.
4. Integrator andDifferentiator.
5. Phase shift and Wien bridge oscillators usingOp-amp.
6. Astable and Monostable multivibrators using NE555Timer.
7. Realization of Logic gates using basicgates
8. Realization of Halfadder and Fulladder using Logicgates
9. Realization of Multiplex and Demultiplexer using Logicgates
10. Realization of Flipflop using Logicgates

18BEME311 MACHINEDRAWING 3 H – 2 C

Instruction hours / week L : 0 T : 0 P:3 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To explain the surfaces for sheet metal working applications.
2. To Understand the representation of details in machine drawing.
3. To introduce tolerances and fits of machine elements.
4. To equip them with skills to Construct an assembly drawing using part drawings of machine components.
5. To equip them with skills to Construct an assembly drawing of machine components using 2D drafting.
6. To equip them with skills to develop employability.

COURSEOUTCOMES

Learners should be ableto

1. Express the importance of machine drawing andGD&T.
2. Interpret drawings of machinecomponents.
3. Create assembled machinedrawings.
4. Make part drawings from an assemblydrawing.
5. Interpret the details of complex parts in cross sectionviews.
6. Sketch production drawing from assemblydrawing.

INTRODUCTION

Introduction to machine drawing. Importance of sectional views. Computer-aided drafting. Introduction to Geometric dimensioning and Tolerancing – working of geometric system – Terms and definitions – Common symbols and Terminology – Fundamental Rules (Drawing)– Feature definition – With Size and Without Size – Material Condition (Maximum, Least, Regard of Material Condition)– Limit Tolerancing – Dimension Origin –Limits of Size

CONVENTIONS

Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs andflanges.

FITS AND TOLERANCES

Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols- methods of indicating the surface roughness. Blue print reading exercises.

ASSEMBLY DRAWING PRACTICE

Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints, C clamp.

ASSEMBLY AND BILL OF MATERIALS USING CAD SOFTWARE

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing and Drill jigs and Milling fixture.

SUGGESTED READINGS

1. Gopalakrishna K R, Machine Drawing, Subhas Stores, Bangalore,2003
2. Ajeet Singh, Machine Drawing: Includes AutoCAD, Tata McGraw Hill, New Delhi,2012
3. Bhatt N. D and Panchal V.M, Machine Drawing, Charotar Publishing House, Chennai,2007
4. ASME Y 14.5M-1994, Dimensioning and Tolerancing, ASME, New York,1995

18BEME351 **APTITUDETRAINING** **1 H – 0 C**

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100**External **: --**Total**:100**

COURSE OBJECTIVES

1. To understand the basic concepts of QUANTITATIVE ABILITY
2. To understand the basic concepts of LOGICAL REASONING Skills
3. To acquire satisfactory competency in use of VERBAL REASONING
4. To solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.
5. To solve off-campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.
6. To compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

COURSE OUTCOMES

1. Understand the basic concepts of QUANTITATIVE ABILITY
2. Understand the basic concepts of LOGICAL REASONING Skills
3. Acquire satisfactory competency in use of VERBAL REASONING
4. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.
5. Solve off-campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.
6. Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

- Introduction, Speed Math's, Problems on Numbers, Averages, Ratios and Proportions, Problems onAges

- Percentage, Data Interpretation, Profit and loss, Simple and Compound Interest

- Time Speed and Distance, Time and Work, Pipes and Cistern, Geometry, Probability, Permutation andCombination

SUGGESTED READINGS

1. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S.Chand Limited,2011
2. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill,2011
3. Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition,2012

18BEME352A WELDINGPROCESS 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To understand the fusion welding processes
2. To learn about the advanced metal joining processes.
3. To understand the fundamental principles of special arc welding process.
4. To work with various metal joiningprocesses.
5. To understand the knowledge of plasma arc in metal joining and cutting process.
6. To understand the fundamental principles of Laser Beam Welding.

COURSE OUTCOMES

Upon completion of this course, the students can ableto
1. Know the methods of metal joiningprocesses.
2. Understand the fundamental principles of special arc welding process.
3. Decide the type of metal joining processes forapplications
4. Work with various metal joiningprocesses.
5. Understand the knowledge of plasma arc in metal joining and cutting process.
6. Understand the fundamental principles of Laser Beam Welding.

UNIT I

Classification of welding processes; Gas welding; Arc welding; arc physics, power source characteristics, Manual metal arc welding: Concepts, types of electrodes and their applications, Gas tungsten arc welding: Concepts, processes and applications; gas metal arc welding, Concepts, processes and applications, types of metal transfer, CO2 welding, pulsed and synergic MIG welding, FCAW. Submerged arc welding; advantages and limitations, process variables and their effects, significance of flux-metal combination and modern development.

UNIT II

Narrow gap submerged arc welding, applications; electro slag and electro gas welding Plasma welding; Concepts, processes and applications, keyhole and puddle-in mode of operation, low current and high current plasma arc welding and their applications; Magnetically impelled arc butt (MIAB) welding Resistance welding, Concepts, types and applications, Flash butt welding, Stud welding and under water welding. Friction welding: Concepts, types and applications. Friction stir welding: Metal flow phenomena, tools, process variables and applications and induction pressure welding: Process characteristics and applications Explosive, diffusion and ultrasonic welding, principles of operation, process characteristics andapplications.

UNIT III

EBW: Concepts, types and applications. LBW: Physics of lasers, types of lasers, operation of laser welding setup, advantages and limitations, applications Soldering: Techniques of soldering, solders, phase diagram, composition, applications Brazing: Wetting and spreading characteristics, surface tension and contact angle concepts, brazing fillers, role of flux and characteristics, atmospheres for brazing, adhesive bonding Cladding, Surfacing and Cutting

SUGGESTED READINGS

1. Schwartz M.,‘ Materials and Applications - Metal Joining Manual’, McGraw-Hill,1979
2. Nadkarni S.V., ‘Modern Arc Welding Technology’, Oxford IBH Publishers,1996
3. Christopher Davis, ‘Laser Welding - A Practical Guide’, Jaico Publishing House,1994
4. Parmar R S, Welding Engineering and Technology, Khanna Publishers,1997
5. Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing,ASM,2007
6. Parmer R. S., ‘Welding Engineering and Technology’, Khanna Publishers,1997
7. Cary, Howard, “Modern Welding Technology’, prentice Hall,1998

18BEME352B WELDINGMETALLURGY 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To understand the basic metallurgical process during welding.
2. To learn the phase diagrams, weldability of ferrous and nonferrousmaterials
3. To understand weld defects and remedialmeasures
4. To understand the development of the fusion and heat-affected zones during the welding.
5. To understand the how metals, solidify, how phases nucleate and grow, and the mechanisms by which metal alloys are strengthened.
6. To understand the how weld variables such as pool shape, travel speed, cooling rate and other variables affect the subsequent weld microstructure.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply influence of heat input and temperature distribution across a weldedstructure.
2. Describe basic physical metallurgy starting at the atomic level, with bonding, defect structure, phase diagrams and diffusion and moves towards the development of metal microstructure.
3. Describe how metals solidify, how phases nucleate and grow, and the mechanisms by which metal alloys are strengthened.
4. Describe the development of the fusion and heat-affected zones during the welding of aluminum.
5. Describe how weld variables such as pool shape, travel speed, cooling rate and other variables affect the subsequent weld microstructure.
6. Determine how the weld variables and weld microstructure affect the mechanical properties of the weld will be able to identify the microstructure of acceptable welds.

UNIT I

Heat flow – Thermal cycles, temperature distribution-cooling rates - influence of heat input, joint geometry, plate thickness, preheat, significance of thermal severity. Number Equaxial growth - weld metal solidification - columnar structures and growth morphology effect of welding parameters - absorption ofgases - gas/metal and slag/metal reactions.

UNIT II

Phase transformations- weld CCT diagrams - carbon equivalent-preheating and post heating-weldability of low alloy steels, welding of stainless steels use of Schaffler and Delong diagrams. Welding of cast irons Welding of Cu, Al, Ti and Ni alloys,– processes, difficulties, microstructures, Joining of Dissimilar Materials

UNITIII

Defects and remedial measures Origin - types - process induced defects, - significance remedial measures, Hot cracking - cold cracking -lamellar tearing - reheat cracking - weldability tests - effect of metallurgical parameters.

SUGGESTED READINGS

1. Linnert G. E.,'Welding Metallurgy', Volume I and II, 4th Edition, AWS,1994
2. Granjon H., 'Fundamentals of Welding Metallurgy', Jaico Publishing House,1994
3. Kenneth Easterling, 'Introduction to Physical Metallurgy of Welding',2nd Edition, Butterworth Heinmann, 1992
4. Saferian D., 'The Metallurgy of Welding', Chapman and Hall,1985
5. Jackson M. D., 'Welding Methods and Metallurgy', Grffin, London,1967

18BEME353 MATERIALTESTINGLABORATORY 3 H – 0 C

Instruction hours / week L : 0 T : 0 P:3 **Marks:** Internal**: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To perform different destructivetesting
2. To learn the characteristicmaterials
3. To understand the stress and strain relationship.
4. To determine the shear force for various materials.
5. To determine the impact load for various materials.
6. To determine the hardness for various materials

COURSE OUTCOMES

1. Ability to perform different destructivetesting
2. Ability to characteristicmaterials
3. Understand the stress and strain relationship.
4. Determine the shear force for various materials.
5. Determine the impact load for various materials.
6. Determine the hardness for various materials

LIST OF EXPERIMENTS

1. Tensile test on welded joints–stress straincharacteristics
2. Hardness test on welded metals–Brinell and Rockwell Hardnesstests.
3. Impact test on welded metals–Charpy, Izod impact tests.
4. Shear test on welded metals–direct shear strength, single shear, doubleshear.

SEMESTER – IV

18BEME401 INSTRUMENTATION ANDCONTROLSYSTEM 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide a basic knowledge about measurement systems and theircomponents
2. To learn about various measurements like displacement, temperature, pressure, level, flow,speed
3. To learn about control systems and itsprinciples.
4. To learn how to measure the quantities like strain, humidity andforce
5. To learn how to measure the quantities like torque andpower
6. To classify the various control methods and its application.

COURSE OUTCOMES

Upon completion of this course, the Students will be able to

1. Understand the measurement systems, their accuracy &range.
2. Measure the quantities like displacement, temperature,pressure
3. Measure the quantities like level, flow andspeed
4. Measure the quantities like strain, humidity andforce
5. Measure the quantities like torque andpower
6. Classify the various control methods and its application and do system models and perform response analysis

UNITI INTRODUCTION

Basic principles of measurement - Measurement systems, generalized configuration and functional descriptions of measuring instruments - examples. Dynamic performance characteristics - sources of error, Classification and elimination of error.

UNITII MEASUREMENTS I

Measurement of Displacement: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures. Measurement of Temperature: Classification-Ranges-Various Principles of measurement -Expansion, Electrical Resistance- Thermistor - Thermocouple- Pyrometers-Temperature Indicators. Measurement of Pressure: Units - classification - different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows - Diaphragm gauges. Low pressure measurement - Thermal conductivity gauges -ionization pressure gauges, McLeod pressure gauge.

UNITIII MEASUREMENTS II

Measurement of Level: Direct method - Indirect methods - capacitative, ultrasonic, magnetic, cryogenic fuel level indicators - Bubbler level indicators. Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot - wire anemometer, Laser Doppler Anemometer (LDA). Measurement of Speed: Mechanical Tachometers - Electrical tachometers - Stroboscope, Non- contact type of tachometer. Measurement of Acceleration and Vibration: Different simple instruments - Principles of Seismic instruments - Vibro meter and accelerator meter using thisprinciple.

UNITIV MEASUREMENTS III

Stress Strain Measurements: Various types of stress and strain measurements - electrical strain gauge - gauge factor — method of usage of resistance strain gauge for bending compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes. Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter. Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters,Dynamometers.

UNITV CONTROLSYSTEMS

Elements of Control Systems: Introduction, Importance - Classification - Open and closed systems Servomechanisms - Examples with block diagrams - Temperature, speed and position control systems. Control method - P, PI, PID, when to choose what, tuning of controllers. System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

SUGGESTED READINGS

1. W. Bolton, Instrumentation and control systems , 2nd edition, Newnes,2015
2. Chennakesava R Alavala, Principles of Industrial Instrumentation and Control Systems, 1st edition, Cengage Learning, 2009.
3. R.K. Jain, Mechanical and Industrial Measurements, 12th edition, Khanna Publishers,1995.
4. Instrumentation Technology Magazine Editors, Instrumentation & control systems engineering handbook, Tab Books, 1978, 2007(Digital).
5. J P Holman, Experimental Methods for Engineers, 1st edition, Tata McGraw Hill Education,2007

18BEME402 ENVIRONMENTALSTUDIES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

COURSE OBJECTIVES

1. To create the awareness about environmental problems amongpeople.
2. To develop an attitude of concern for theenvironment.
3. To motivate public to participate in environment protection andimprovement.
4. To demonstrate proficiency in quantitative methods, qualitative analysis, and critical thinking.
5. To develop writing and oral communication needed to conduct high-level work as interdisciplinary scholars and / orpractitioners.
6. To Learn about the systems concepts and methodologies to analyze and understand interactions.

COURSE OUTCOMES

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problemsolving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies andinstitutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to globalscales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnectedworld.

UNITI INTRODUCTION - ENVIRONMENTAL STUDIES &ECOSYSTEMS

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNITII NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources - Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNITIII BIODIVERSITY AND ITSCONSERVATION

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNITIV ENVIRONMENTALPOLLUTION

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Casestudies.

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development. Water conservation - Rainwater harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

SUGGESTED READINGS

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, NewDelhi.
2. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, NewDelhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, NewDelhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc.,New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand& Company Pvt. Ltd., New Delhi.
6. Odum, E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia:Saunders.
7. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford UniversityPress.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, NewDelhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, NewDelhi.
10. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, NewDelhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology). S. Chand and Company Ltd, NewDelhi.
12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, NewDelhi.

18BEME441 ENGINEERING MATERIALS ANDMETALLURGY 3 H – 3 C

(Theory & Lab)

Instruction hours / week L : 3 T : 0 P:0 Marks: Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To impart knowledge on metallurgical aspects ofmetals.
2. To understand heat treatment processes on different grades ofsteel.
3. To familiarize on selection of ferrous and non-ferrous materials for variousapplications.
4. To impart knowledge on non-metallicmaterials
5. To learn about the strengthening mechanisms for Non-ferrousalloys.
6. To comprehend the significance of Non-Destructive Testing (NDT)methods

COURSEOUTCOMES

Learners should be ableto

1. Identify the metallurgical aspects ofmetals.
2. Identify suitable heat treatment processes for variousapplications.
3. Select appropriate ferrous and non-ferrous materials for variousapplications.
4. Identify and select suitable non-metallicmaterials.
5. Identify suitable strengthening mechanisms for Non-ferrousalloys.
6. Work with non-destructive testingmethods.

UNITI CONSTITUTION OF ALLOYS AND PHASEDIAGRAMS

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram -Classification of steel and cast Iron, microstructure, properties and applications.

UNITII HEATTREATMENT

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on TTT diagram, CCT - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening, Microstructure study and specimen preparation.

UNITIII FERROUS AND NON-FERROUSMETALS

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti& W) - stainless and tool steels – HSLA - maraging steels – Gray, White malleable, Spheroidal Graphite irons - Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation, strengthening treatment – Bearing alloys.

UNITIV NON-METALLIC MATERIALS

Polymers – types of polymer, commodity and engineering polymers – Properties and Applications of thermoplastics (PP, PVC, ABS, and PMMA) and thermosetting plastics (PF, UF, MF) –Engineering Ceramics.

UNITV TESTING OF MECHANICAL PROPERTIES ANDINSPECTION

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep test, S-N curve.

SUGGESTED READINGS

1. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials: Properties and Selection, 9th Edition, Prentice-Hall of India Private Limited, New Delhi,2010
2. William D. Callister&David G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, 5thedition, International Student Version, John Wiley & Sons, Inc.,2016
3. Raghavan. V, Materials Science and Engineering, 6thedition, Prentice Hall of India Pvt. Ltd, New Delhi, 2015.
4. James F. Shackelford, Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers, 6th edition, Pearson Education, India,2014

(ii) Laboratory

COURSE OBJECTIVES

1. To impart knowledge on metallurgical aspects ofmetals.
2. To understand heat treatment processes on different grades ofsteel.
3. To familiarize on selection of ferrous and non-ferrous materials for variousapplications.
4. To review physics and chemistry in the context of materials science & engineering.
5. To describe the different types of bonding in solids, and the physical ramifications of these differences.
6. To describe and demonstrate diffraction, including interpretation of basic x-ray data.

COURSEOUTCOMES

Learners should be ableto

1. Identify the metallurgical aspects ofmetals.
2. Identify suitable heat treatment processes for variousapplications.
3. Select appropriate ferrous and non-ferrous materials for variousapplications.
4. Identify and select suitable non-metallicmaterials.
5. Able to perform corrosiontest.
6. Able to describe a polymer's elastic behavior above and below the glass transition.

LIST OF EXPERIMENTS

1. Study and use of metallurgical microscope (TermPaper).
2. Metallographic specimen preparation, mechanical polishing, mounting, andetching.
3. Microstructure of annealed pure metals-iron, copper, lead, zinc aluminium and use of specificetchants.
4. Macro etching and sulphurprinting.
5. Electropolishing.
6. Comparative study of microstructure of annealed steel (Hypo eutectoid, Eutectoid, Hyper eutectoid) and variation ofhardness.
7. Microstructure of Cast Iron (Gray, White,Nodular).
8. Microstructure of eutectic alloys Al-Si, Pb-Sn, andPb-Sb.
9. Microstructure of wrought and annealed single-phase alpha brass &Aluminium.
10. Recovery, Recrystallisation and Grain growth of cold workedcopper.
11. Galvanostatic polarization & determination of corrosion rate by Tafel'sExtrapolation
12. Potentiostatic Polarization, passivity & Passivity breakdownstudy

18BEME442 APPLIEDTHERMODYNAMICS 6 H – 5 C

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To incorporate the concepts and laws in thermodynamic analysis of cyclicprocesses.
2. To impart the mechanisms of combustion offuels.
3. To apply the thermodynamic concepts in steam turbines andnozzles.
4. To learn about the performance ofcompressors.
5. To understand the concept of cogeneration and waste heat recovery in engineeringapplications.
6. To introduce concepts of refrigeration and air conditioning in engineeringapplications

COURSE OUTCOMES

Learners should be able to

1. Calculate the efficiency of various gas powercycles.
2. Calculate the performance characteristics ofengines.
3. Analyze combustion mechanism in ICengines.
4. Evaluate the characteristic of steam turbines andnozzles.
5. Evaluate the performance characteristics ofcompressors.
6. Identify and utilize the concepts of refrigeration and air conditioning in engineeringapplications

UNITI GAS POWER CYCLES AND ICENGINES

Otto, Diesel, Dual, Brayton cycles – Calculation of mean effective pressure and air standard efficiency – actual and theoretical PV and TS diagrams of two stroke and four stroke engines–valve timing diagram and port timing diagram – calculation of engine performance, heat balance sheet, retardation – Morse test.

UNITII BOILER AND STEAM POWERCYCLES

Generation of steam, Boiler–Classification, fire tube boiler, water tube boiler, comparison, boiler mountings and accessories, performance of steam boilers – dryness fraction, properties of steam, T–S diagram, Mollier diagram, steam tables, Rankine Cycle – incomplete evaporation – superheated steam –modified cycle.

UNITIII STEAM NOZZLES AND STEAMTURBINES

Steam nozzles – flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow – Steam turbines– impulse and reaction turbine, compounding, velocity diagram, condition for maximum efficiency .

UNITIV AIR COMPRESSORS

Classifications of compressors – Reciprocating air compressor – performance characteristics, effect of clearance volume, free air delivery and displacement, intercooler, after cooler – Rotary compressor – vane type, centrifugal and axial, flow performancecharacteristics.

UNITV REFRIGERATION AND AIRCONDITIONING

Fundamentals of refrigeration – COP – Vapour compression refrigeration system – cycle, p–h chart, Vapour absorption system – comparison, properties of refrigerants. Fundamentals of air conditioning system, cycle, controls, air handling and distribution, simple cooling and heat load estimation

(Permitted to use standard thermodynamic table, Mollier diagram, Psychometric chart and Refrigeration property table in the examination)

SUGGESTED READINGS

1. Rajput R.K, Thermal Engineering, 10th Edition, Laxmi Publications, New Delhi,2018
2. Arora C.P, Refrigeration and Air conditioning, 3rd edition, Tata McGraw–Hill, New Delhi,2008
3. Kothandaraman C.P, and Domkundwar A.V, A course in Thermal Engineering, 5thEdition, Dhanpat Rai and Sons, Delhi,2006
4. Ganesan V, Internal Combustion Engines, 4thedition, Tata McGraw–Hill, New Delhi,2012
5. Yunus A Cengel, Thermodynamics' An Engineering Approach, 8thedition, Tata McGraw Hill, New Delhi, 2015

(i) Laboratory

COURSEOBJECTIVES

1. Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steamturbines.
2. To appreciate concepts learnt in fundamental laws of thermodynamics.
3. To learn ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.
4. To communicate effectively the concepts of internal combustion engines.
5. To make the students to prepare them to carry out experimental investigation and analysis at later stages of graduation.
6. To make the students to think beyond curriculum in alternative sources of energy.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. conduct experiment on IC engine to study the characteristic and performance of ICEngine
2. conduct experiment to find the thermo physical properties of givenfluid.
3. Understand the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
4. Can formulate power production based on the fundamental laws of thermal engineering.
5. Understand instill upon to envisage appropriate experiments related to heat engines.
6. Understand and investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.

LIST OF EXPERIMENTS

I C ENGINES AND FUELS

1. Valve Timing and Port TimingDiagrams.
2. Performance Test on 4–stroke CIEngine.
3. Heat Balance Test on 4–stroke CIEngine.
4. Load test on 4–stroke CIEngine.
5. Morse Test on multicylinder SIEngine.
6. Retardation Test to find Frictional Power of a CIEngine.
7. Determination of Viscosity – Red WoodViscometer.
8. Determination of Flash Point and FirePoint.
9. Performance test on single/two stage reciprocating aircompressor.
10. Determination of COP of a refrigerationsystem
11. Experiments on air–conditioningsystem

18BEME443 **STRENGTH OFMATERIALS** **6 H – 5 C**

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To understand the concepts of stress and strain on deformation of solids.
2. To introduce the Concepts of safe working stresses and load carrying capacity of beams.
3. To enrich the understanding of deflection in beams and columns in engineering applications.
4. To understand the importance of the effect of torsion on shafts and springs.
5. To provide knowledge on principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. To provide knowledge on components subjected to various loadings with the help of various theories of failures.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Determine stress and strain on deformation of solids.
2. Compute safe working stresses and load carrying capacity of beams.
3. Estimate the deflection in beams and columns in engineering applications.
4. Analyze the effect of torsion on shafts and springs.
5. Determine principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. Design the components subjected to various loadings with the help of various theories of failures.

UNIT I STRESS, STRAIN AND DEFORMATION OFSOLIDS

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxialloads.

UNITII BEAMS – LOADS ANDSTRESSES

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Relationship between load, shear force and bending moment – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III BEAMDEFLECTION

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Macaulay Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine's formula forcolumns

UNITIV TORSION

Analysis of torsion of circular bars – Torsional Shear stress – Bars of solid and hollow circular section – Stepped shaft –Torsional rigidity – Compound shafts – Fixed and simply supported shafts – Application to close–coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads.

UNITV ANALYSIS OF STRESSES IN TWODIMENSIONS

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress – Strain energy in bending and torsion.

SUGGESTED READINGS

1. Punmia B.C and Jain A.K, Strength of Materials, 10th Edition, Laxmi Publications New Delhi,2018
2. Ramamrutham S and Narayan R, Strength of Materials, 1st Edition, Dhanpat Rai and Sons., New Delhi, 2008
3. Jindal U C, Strength of Materials, 2nd Edition, Pearson education Ltd, Chennai,2018
4. Don H Morris, and Leroy D Sturges, Mechanics of Materials, 6th Edition, John Wiley and Sons Inc,2011
5. Bedi D S, Strength of Materials, 6th Edition, Khanna Book Publishing Company (P) Limited., New Delhi, 2013

(ii) Laboratory

COURSE OBJECTIVES

1. To perform different destructivetesting
2. To learn the characteristicmaterials.
3. To understand the stress and strain relationship.
4. To determine the shear force for various materials.
5. To determine the impact load for various materials.
6. To determine the hardness for various materials

COURSE OUTCOMES

1. Ability to perform different destructivetesting
2. Ability to characteristicmaterials
3. Understand the stress and strain relationship.
4. Determine the shear force for various materials.
5. Determine the impact load for various materials.
6. Determine the hardness for various materials

LIST OF EXPERIMENTS

1. Tensile test on metals–stress straincharacteristics
2. Cupping test on metal sheets–load deformation characteristics, cupping load, cuppingnumber.
3. Hardness test on metals–Brinell and Rockwell Hardnesstests.
4. Impact test on metals–Charpy, Izod impacttests.
5. Shear test on metals–direct shear strength, single shear, doubleshear.
6. Tests on helical springs–compression, tension springs–load deformation characteristics, stiffness, shear stress, modulus of rigidity,energy.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity,energy.

18BEME444 FLUID MECHANICS & FLUIDMACHINES 6 H – 5 C
(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To enrich the understanding of fluid properties
2. To make the students conversant with types of flow and calculate Major and minor loses in pipes.
3. To acquaint the student with the concepts of Buckingham's π theorem.
4. To explain the working of different pumps
5. To explain the working of different turbines.
6. To equip students with skills to produce analytical solutions to various simple problems

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Demonstrate basic knowledge of fluid properties
2. Find types of flow and calculate Major and minor loses in pipes.
3. Apply Buckingham's π theorem for problem solving.
4. Understand the working of different pumps
5. Understand the working of different turbines.
6. produce analytical solutions to various simple problems

UNITI FLUID PROPERTIES AND FLOWCHARACTERISTICS

Fluid properties: Mass density, weight density, specific gravity, viscosity, compressibility, surface tension and capillarity. Buoyancy and floatation– metacentre and metacentric height (definition only)
Flow characteristics: concepts of system and control volume, applicationof control volume to continuity equation, energy equation, momentum equation and moment ofmomentum equation.

UNITII FLOW THROUGH CIRCULAR PIPES

Hydraulic and energy gradient – Types of fluid flow – Laminar flow through circular conduits – Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor – Moody diagram– minor losses – Flow through pipes in series and parallel.

UNITIII DIMENSIONALANALYSIS

Dimension and units, dimensional homogeneity, applications of Buckingham's π theorem, model and similitude, similaritylaws.

UNITIV HYDRAULIC TURBINES

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

UNITV HYDRAULICPUMPS

Classification of pumps – centrifugal pump–working principle–head, discharge, efficiencies and losses – performance curves – specific speed. Reciprocating pump–components and working–slip–indicator diagram – air vessel – Jet pump.

SUGGESTED READINGS

1. Victor L Streeter, E. Benjamin Wylie and K.W. Bedford, Fluid Mechanics, 9e, McGraw–Hill, New Delhi, 2010
2. Prof. Kumar K.L, Engineering Fluid Mechanics, 1st Edition, S. Chand publishers,2016
3. Bansal. R.K, A Text book of Fluid Mechanics and Hydraulics Machines, 10th edition, Laxmipublications (P) Ltd, New Delhi, 2018
4. White. F.M, Fluid Mechanics, 8thedition, Tata McGraw–Hill, New Delhi,2016
5. Fox and McDonald, Fluid Mechanics, 8theditон, John Wiley,2015

(ii) Laboratory

COURSE OBJECTIVES

1. To supplement the theoretical knowledge gained in Fluid Mechanics and Machinery with practical testing
2. To understand the concepts of coefficient of discharge for Orifice meter and Venturi meter.
3. To explain the Calibration of Rotameter.
4. To understand the importance of friction factor for flow through pipes.
5. To impart knowledge on the performance of various pumps.
6. To impart knowledge on the performance of turbines.

COURSE OUTCOMES

1. Calculate the coefficient of discharge for Orifice meter and Venturimeter.
2. Calibrate the Rotameter
3. Estimate the friction factor for flow through pipes.
4. Asses the performance of centrifugal pump and submergible pump.
5. Asses the performance of reciprocating pump and gear pump.
6. Asses the performance of turbines.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of givenVenturimeter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set ofpipes.
5. Conducting experiments and drawing the characteristic curves of centrifugalpump
6. Conducting experiments and drawing the characteristic curves of submersiblepump
7. Conducting experiments and drawing the characteristic curves of reciprocatingpump.
8. Conducting experiments and drawing the characteristic curves of Gearpump.
9. Conducting experiments and drawing the characteristic curves of Peltonwheel.
10. Conducting experiments and drawing the characteristics curves of Francisturbine.

18BEME451 TECHNICALPRESENTATION 1 H – 0 C

Instruction hours / week L: 1 T: 0 P:0 **Marks:** Internal: **100** External: **---** Total**:100**

COURSE OBJECTIVES

1. To equip the students with effective technicalpresentation
2. To understand the barriers and bridges tocommunication
3. To improve the public speaking capabilities, body language andposture.
4. To improve the literature survey skill.
5. To develop presentation skill using power point presentation
6. To improve skill to face viva voce examination.

COURSE OUTCOMES

1. Develop the ability to fabrication skill.
2. Ability to make literature review till the successful solution.
3. Ability to identify specific problems.
4. Gain the knowledge about data collection and conducting experiments.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also, Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models to present their work done.

18BEME452A WELDING ECONOMICSANDMANAGEMENT 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: ---** Total**:100**

COURSE OBJECTIVES

1. To know the weld design, fitup, timestandards.
2. To learn the cost,mechanization.
3. To understand the welding and efficientoperation.
4. To impart knowledge regarding various advanced welding practices in industries
5. To understand the various parameters and requirements for welding processes.
6. To know the comparative merits and demerits of various welding processes

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable welding methods forjoining.
2. Know the cost involved duringwelding.
3. Enhance the efficiency of the metal joiningprocesses.
4. Students are introduced to various advanced welding techniques which make them interested to choose a career in the field of welding.
5. Students will understand the advanced welding practices in Industries and their comparative merits and demerits.
6. Students will be able to choose the right kind of welding techniques for joining raw materials of various thicknesses.

UNIT I

Welding design, selection of electrodes, size, type and metal recovery, electrode efficiency, stub thrown away, over welding and joint, fit - up welding position operation factor, Jigs, fixtures, positioners, operator efficiency Need for time standards, definition of standard time, various methods of computing standard time, analytical calculation, computerization of time standards

UNIT II

Definition of terms, composition of welding costs, cost of consumables, labour cost, cost overheads, formulae for total cost, cost curves for different processes like CO2 , SAW, ESW, etc., Mechanization in welding, job shop operation Process vs product layout, construction, service consideration, employees, services, process services, etc., different work stations in shop floor and their arrangements

UNIT III

Selection and installation of equipment, safe handling of equipment, production control, planning for welding processes and materials, inventory control; basic aspects of financial management and man power planning

SUGGESTED READINGS

1. Bathy J., ‘Industrial Administration and Management’,1984
2. Pendar J. A., ‘Welding Projects - A Design Approach’,1977
3. Welding Institute U.K., ‘Standard Data for Arc Welding’,1994

18BEME452B **PROCESSMODELING** **2 H – 0 C**

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: ---** Total**:100**

COURSE OBJECTIVES

1. To know the modeling and simulation of theprocess.
2. To apply analytical techniques to weldingprocesses.
3. To solve finite element problems in 2D & 3D using FEM software.
4. To analyses liquid metal flow through CFD software.
5. To understand the concept of artificial intelligence (AI).
6. To understand the concept of robotics configuration for demonstrate the model.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Understand the weldingphenomena
2. Apply suitable analytical process for various metal joiningprocess
3. Apply FEM to solve real time problems in 2D & 3D.
4. Understand concept of CFD software to analysis the liquid metal flow.
5. Understand the concept of artificial intelligence (AI).
6. Understand the concept of robotics configuration for demonstrate the model.

UNIT I

Mathematical modeling, physical simulation, advantages and limitations; process control, instrumentation and data acquisition systems Review of transport phenomena, differential equations & numerical methods; concept of physical domain and computational domain, assumptions and limitations in numerical solutions

UNIT II

Introduction to FEM & FDM, examples Introduction to software packages– useful websites and generic information about different products - ANSYS, Thermocalc, CFD; usage of expert systems, artificial intelligence and robotics; demonstration of some software packages Physical modeling – cold and hot models; case studies of water models, use of computers for the construction of phase diagrams, alloy design, crystallography, phase transformations and thermo chemical calculations.

UNIT III

Case studies from literature – pertaining to modeling of solidification / heat transfer, fluid flow, casting, welding and liquid metaltreatment

SUGGESTED READINGS:

1. Szekely J., Themelis N. J., ‘Rate Phenomena in Process Metallurgy’, Wiley,1971

2. P.S. Ghosh Dastidar, “Computer Simulation of Flow and Heat Transfer”, Tata McGraw Hill, New Delhi, 1998

18BEME453 MINI PROJECT- ION WELDING 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal**: 100** External**: ---** Total**:100**

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students may be grouped into maximum of 4 students and work under the guidance of the supervisor. A project report to be submitted by the group and the course oriented project working model or demo model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Centralized Production and ServiceFacility

SEMESTER – V

18BEME501 DESIGN OFMACHINEELEMENTS 4 H – 4 C

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the various types of stresses induced in different machine members.
2. To Study and acquire knowledge on design shaft and couplings for effective transmission of power.
3. To study the features of welded joints and fasteners required for various industrial applications.
4. To give exposure to design springs and flywheels for various engineering applications.
5. To understand the importance design bearings and levers for engineering applications.
6. To make the students conversant to implement design procedure for designing a machine.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Determine various types of stresses induced in different machine members.
2. Design shaft and couplings for effective transmission of power.
3. Select the type of welded joints and fasteners required for various industrial applications.
4. Design springs and flywheels for various engineering applications.
5. Design bearings and levers for engineering applications.
6. Implement design procedure for designing a machine.

UNITI STEADY STRESSES AND VARIABLE STRESSES IN MACHINEMEMBERS

Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Factor of safety. Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading.

UNITII DESIGN OF SHAFTS AND COUPLINGS

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints.

UNITIII DESIGN OF FASTENERS AND WELDEDJOINTS

Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures – theory of bonded joints.

UNITIV DESIGN OF SPRINGS ANDFLYWHEEL

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs – Belleville springs – Design of flywheels involving stresses in rim and arm.

UNITV DESIGN OF BEARINGSANDLEVERS

Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of Levers.

(Permitted to use design data book in the examination)

SUGGESTED READINGS

1. Juvinall R.C and Marshek K.M, Fundamentals of Machine Component Design, 5th edition, John Wiley and Sons, New Delhi, 2015
2. Bhandari V.B, Design of Machine Elements, 4th edition, Tata McGraw–Hill Book Co, New Delhi,2016
3. Orthwein W, Machine Component Design, Jaico Publishing Co., New Delhi,2013
4. Bhandari V B, Introduction To Machine Design, 2nd edition, Tata McGraw–Hill Book Co., New York, 2013
5. Spotts M.F, Shoup T.E, Design of Machine Elements, 8th Edition, Pearson Education, New Delhi,2019

18BEME541 HEAT AND MASSTRANSFER 6 H – 5 C

Theory & Lab

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To Study and acquire knowledge on heat transfer for conduction.
2. To introduce the concepts of heat transfer coefficients for natural and forced convection for different fluid flows.
3. To understand the performance of heat exchanger.
4. To study the features of radiation heat transfer between the surfaces.
5. To give exposure to mass transfer.
6. To make the students conversant to solve complex problems where heat and mass transfer takes place.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Determine the rate of heat transfer for conduction.
2. Evaluate heat transfer coefficients for natural and forced convection for different fluid flows.
3. Analyze performance of heat exchanger.
4. Estimate the radiation heat transfer between the surfaces.
5. Calculate the coefficient of mass transfer.
6. Solve complex problems where heat and mass transfer takes place.

UNITI CONDUCTION

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of HeislersChart.

UNITII CONVECTION

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes.

UNITIII PHASE CHANGE HEAT TRANSFER AND HEATEXCHANGERS

Nusselts theory of condensation–pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNITIV RADIATION

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation –Grey body radiation - Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

UNITV MASS TRANSFER

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

(Permitted to use standard Heat and Mass Transfer Table in the examination)

SUGGESTED READINGS

1. Sachdeva R.C, Fundamentals of Engineering Heat and Mass Transfer, 4th edition, New Age International, New Delhi,2012
2. Frank P. Incropera and David P. DeWitt, Fundamentals of Heat and Mass Transfer, 7th edition, John Wiley and Sons, New Delhi,2011
3. Jack P. Holman, Heat Transfer, 10th edition, McGraw–Hill Book Co, New Delhi,2017
4. Kothandaraman C.P, Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, New Delhi,2015

(ii) Laboratory

COURSE OBJECTIVES

1. To ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steamturbines.
2. To apply Fourier's law to validate the theoretical over all heat transfer coefficient.
3. To apply Stefan-Boltzmann law of radiation and emissivity relation.
4. To determine thermal properties of material by applying 1-D steady state heat transfer equation.
5. To apply non-dimensional numbers to evaluate and validate heat transfer parameters.
6. To ability to understand and solve conduction, convection and radiation problems.

COURSE OUTCOMES

1. Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steamturbines.
2. Apply Fourier's law to validate the theoretical over all heat transfer coefficient.
3. Apply Stefan-Boltzmann law of radiation and emissivity relation.
4. Determine thermal properties of material by applying 1-D steady state heat transfer equation.
5. Apply non-dimensional numbers to evaluate and validate heat transfer parameters.
6. Ability to understand and solve conduction, convection and radiation problems.

HEAT TRANSFER

1. Heat transfer through a compositewall
2. Thermal conductivity measurement by guarded platemethod
3. Natural convection heat transfer from a verticalcylinder
4. Heat transfer from pin–fin (natural and forced convectionmodes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmannconstant
7. Determination of emissivity of a greysurface

18BEME542 MANUFACTURING TECHNOLOGYI 6 H – 5 C

(Theory & Lab)

Instruction hours / week L : 4 T : 0 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To familiarize the students to apply suitable molding and casting methods for producing components.
2. To develop anunderstanding of types of metal joining processes.
3. To explain types of deformation processes.
4. To understand the concept of sheet metal operations and metal forming processes.
5. To provide an overview of various plastic component manufacturing processes for various applications.
6. To Study and acquire knowledge of process variables to manufacture defect free products.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable molding and casting methods for producing components.
2. Decide the type of metal joining processes.
3. Select the type of deformation processes.
4. Work with various sheet metal operations and metal forming processes.
5. Select the various plastic component manufacturing processes for various applications.
6. Identify the effect of process variables to manufacture defect free products.

UNITI CASTING PROCESSES

Sand Casting: Sand Mould – Pattern making: Pattern Materials, Pattern types and Pattern allowances – Moulding Sand properties and testing – Cores –Types and applications. Melting Furnaces: Cupola, Electric and Induction Furnaces. Special Casting Processes: Shell - Investment – Die casting - Centrifugal Casting – Stir casting. Casting Defects and Inspection of Casting: Destructive and Non-Destructive Testing(NDT) Methods.

UNITII JOINING PROCESSES

Basics of Welding – Classification of welding methods. Gas welding - Types – Flame characteristics. Arc Welding: Manual Metal Arc Welding – MIG and TIG Welding – Submerged arc welding –Operating principle and applications of: Resistance Welding - Plasma Arc welding– Electron Beam welding - Soldering and Brazing- WeldDefects.

UNITIII METAL FORMINGPROCESSES

Hot working and cold working of metals – Forging processes – Open and Closed Die Forging – Forging operations. Rolling: Types of Rolling Mills -Applications – Defects in rolled parts. Extrusion – Forward and Backward Extrusion.

UNITIV SHEET METALOPERATIONS

Sheet metal characteristics – Operations: Shearing, Bending and Drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Metal spinning – Explosive forming: Confined and Unconfined system-Magnetic pulse forming.

UNITV POWDER METALLURGYPROCESS

Introduction to Powder Metallurgy process – Preparation of powders – types and functions of binders – blending - green compaction – sintering process and its effect on the product. Applications.

SUGGESTED READINGS

1. SeropeKalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education, Inc., New Delhi,2014
2. D. K. Singh, Manufacturing Technology, 2nd edition, Pearson Education, Inc., New Delhi,2008
3. P.N. Rao, Manufacturing Technology: Vol I, 4th edition, Tata McGraw–Hill Publishing Limited, New Delhi,2013
4. P.C. Sharma, A text book of production technology, 4thEdition, S. Chand and Company, New Delhi,2014
5. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9thedition, John Wiley and Sons, 2005.

(ii) Laboratory

COURSE OBJECTIVES

1. To teach the process-level dependence of manufacturing systems throughtolerances
2. To select appropriate Manufacturing Processing to manufacture any component
3. To expose the students to a variety of manufacturing processes including their typical use andcapabilities.
4. To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most commonprocesses.
5. To explain and relate the basics of hot and cold working process, their advantages, Limitations and Applications
6. To explain basic principles of working of machine tools viz. Lathe, Milling, Grinding, Drilling machines etc.

COURSE OUTCOMES

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

1. Understand the idea for selecting materials forpatterns.
2. Types and allowances of patterns used in casting and analyze the components ofmoulds.
3. Design core, core print and gating system in metal castingprocesses
4. Understand the application of arc and gas welding inindustries.
5. Understand the principle behind the sheet metal formingprocess
6. Understand the working of the powder metallurgyprocess

LIST OF EXCERCISES

METAL CASTING:

- Pattern Design and making – for one castingdrawing.
- Sand properties testing – Exercise -for strengths, andpermeability
- Moulding Melting andCasting

WELDING:

- Exercises in ARCWelding
- Exercises in GASWelding

SHEET METAL FORMING

- Develop a flat blank layout from an assembly print, transfer the layout to the sheet metal, cut and form to the desiredshape

POWDER METALLURGY

- Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metalparts.

18BEME543 THEORY OFMACHINES 6 H – 5 C

(Theory & Lab)

Instruction hours / week L : 3 T : 1 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and cam mechanisms for specified outputmotions.
2. To understand the basic concepts of toothed gearing and kinematics of gear trains and theeffects of friction in motion transmission and in machinecomponents.
3. To understand the force-motion relationship in components subjected to external forces and analysis of standardmechanisms.
4. To understand the concept of inertia force and inertia torque.
5. To understand the undesirable effects of unbalances resulting from prescribed motions inmechanism.
6. To understand the effect of Dynamics of undesirablevibrations.

COURSE OUTCOMES

Upon completionof this course, the students can able to

1. Identify the type and mechanism and will be able to perform velocity and accelerationanalysis
2. Classify the types of friction and understand the friction applications used in screw threads, clutches, brakes.
3. Specify the gear terminology and to select appropriate gear trains for engineeringapplications.
4. Perform force analysis of reciprocating engine and balancing of rotating & reciprocatingmasses.
5. Describe the vibration phenomenon and its types along with the vibrationterminologies.
6. Analyze the systems subjected tovibration.

UNITI MECHANISMS

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Displacement, velocity and acceleration – analysis in simple mechanisms – Graphical Method –velocity and acceleration polygons.

UNITII FRICTION

Surface contacts–Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

UNITIII GEARING ANDCAMS

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

UNITIV FORCE ANALYSIS ANDBALANCING

Dynamic force analysis- Inertia force and Inertia torque – D'Alemberts principle – The principle of superposition – Dynamic Analysis in Reciprocating Engines - Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine – Balancing Multi–cylinder Engines

UNITV VIBRATION

Free vibration – Equations of motion – natural frequency – Damping Types of Damping – Damped vibration, critical speeds of simple shaft. Response to periodic forcing – Harmonic Forcing – Forcing caused by unbalance – Support motion – Force transmissibility and amplitude transmissibility – Vibration isolation.

SUGGESTED READINGS

1. Rattan S.S, Theory of Machines, 4th edition, Tata McGraw–Hill Publishing Company Ltd., New Delhi, 2014
2. Shigley J.E, Uicker J.J, Theory of Machines and Mechanisms, 10th edition, McGraw–Hill, New York, 2014
3. Rao J.S., Dukkipati R.V, Mechanism and Machine Theory, 2nd edition, New Age International publishers, 2014
4. Charles E. Wilson, Kinematics and Dynamics of Machinery, 3rd edition, Pearson Education Ltd,2008
5. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers and Distributors, New Delhi,2005

(ii) Laboratory

COURSEOBJECTIVES

1. To supplement the principles learnt in kinematics and Dynamics ofMachinery.
2. To gaining knowledge about designing components subjected to fluctuating loads like beam, shaft.
3. To competent enough to design gear and can design gear box system projects.
4. To understand the concept of lubrication and able to design the sliding contact bearings.
5. To understand the approach of statistic in designing and competent enough to design simple machine components by optimum design.
6. To understand the basic principles of aesthetic and ergonomic considerations in design of machine parts, concept of design for manufacture and able to design the flywheel.

COURSE OUTCOMES

Upon completion of this course students will be able to

1. Determine the various parameters of governors, Cam &Gyroscopes
2. Determine the critical speed of a givenshaft
3. Perform balancing of rotating and reciprocatingparts
4. Determine the natural frequency of a givensystem
5. Determine the mass moment of inertia of a givencomponent
6. Determine the damping coefficient of a single degree freedomsystem

LIST OF EXPERIMENTS

1. Governors – Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring-controlled Governors
2. Cam – Determination of jump speed and profile of thecam.
3. Motorized Gyroscope–Verification of laws –Determination of gyroscopiccouple.
4. Whirling of shaft–Determination of critical speed of shaft with concentratedloads.
5. Balancing of rotating and reciprocatingmasses.
6. Determination of moment of inertia by oscillation method for connecting rod andflywheel.
7. Vibrating system – spring mass system – Determination of damping co–efficient of single degree of freedomsystem
8. Determination of torsional frequencies for compound pendulum and flywheel system withlumped moment of inertia.
9. Transverse vibration –free– Beam. Determination of natural frequency and deflection ofbeam.

18BE_____ **OPEN ELECTIVE– I** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3 Hours

Students will select the open elective course from the set of open electives offered by various departments which are listed in the table of curriculum.

18BEME551 ESSENCE OF INDIANTRADITIONALKNOWLEDGE 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100** External **: ---**Total**:100**

COURSE OBJECTIVES

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledgesystem.
2. To know the need and importance of protecting traditionalknowledge.
3. To know the various government acts and rules for protection ofTK.
4. To know the various enactments related to the protection of traditionalknowledge.
5. To understand the concepts of Intellectual property to protect the traditionalknowledge.
6. To know the traditional knowledge in different sectors like engineering, medicineetc.

COURSE OUTCOMES

Upon completion of the course, the students are expected to:

1. Understand the concept of Traditional knowledge and itsimportance
2. Know the need and importance of protecting traditionalknowledge.
3. Know the various government acts and rules for protection ofTK
4. Know the various enactments related to the protection of traditionalknowledge.
5. Understand the concepts of Intellectual property to protect the traditionalknowledge.
6. Know the traditional knowledge in different sectors like engineering, medicineetc.

UNITI INTRODUCTION

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNITII PROTECTION OFTK

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNITIII GOVERNMENTACTS

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFRAct);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

UNITIV INTELLECTUAL PROPERTY RIGHTS

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNITV TK IN DIFFERENT SECTORS

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

SUGGESTED READINGS

1. Traditional Knowledge System in India, by Amit Jha,2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin KumarSingh, Pratibha Prakashan2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers,2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2

18BEME552 GEOMETRICAL DIMENSIONINGANDTOLERANCE 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100**External **: ---**Total**:100**

COURSE OBJECTIVES

1. To understand the concepts of geometrical dimensioning andTolerancing
2. To study the physical importance of them in industrial point ofview
3. To know the various types of Tolerancing, its measurement anddesign.
4. To translate geometric callouts into plain English with one meaning.
5. To explain the major rules found in ASME Y14.5-2009
6. To understand the hierarchy of geometric tolerancing.

COURSE OUTCOMES

1. Ability to learn and apply geometric dimensioning and tolerance standards to communicate designintent
2. Ability to Learn how the knowledge of certain processes can affect part design anddocumentation
3. Gain added insight on working in a team designenvironment.
4. Translate geometric callouts into plain English with one meaning.
5. Explain the major rules found in ASME Y14.5-2009
6. Understand the hierarchy of geometric tolerancing.

INTRODUCTION

Introduction to Geometric dimensioning and Tolerancing – working of geometric system – Terms and definitions – Common symbols and Terminology – Fundamental Rules (Drawing)– Feature definition – With Size and Without Size – Material Condition (Maximum, Least, Regard of Material Condition)– Limit Tolerancing – Dimension Origin –Limits of Size, Rule 1 or Envelope Principle – Go– No Go Gauges.

FORM AND ORIENTATION TOLERANCE

Design considerations – Flatness and Circularity measurement concepts – Orientation tolerance specification and application design.

POSITION AND RUNOUT TOLERANCE

Profile of surface and line tolerance design and application – Location tolerance, Position, applied and material condition consideration – Coaxial controls and design – Concentricity, Symmetry – Measurement and application – Design considerations – Position, Composite tolerance concept, design and Measurement – Runout, Total Runout tolerances – Measurement and considerations.

SUGGESTED READINGS

- Siddeshwar and Kanniah, Machine Drawing, Tata McGraw Hill,2001
- Gopalakrishna, K.R, Machine Drawing, , Subhas Stores,2002
- Wade. O, Tolerance Control in design and manufacturing, Industrial Press,1972
- STANDARDS - IS :10714,10715,10716,10717,11669,10719,813,919,2709,8000 pt 1 to 10721,11158 and AWS/ISO

18BEME553A WELDINGAPPLICATIONTECHNOLOGY 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: ---** Total**:100**

COURSE OBJECTIVES

1. To know the industrial weldingapplications
2. To be familiar with the materials processes industryapplications.
3. To apply the knowledge of solid-state welding process for engineering applications.
4. To understand the principles of radiant energy metal joining process.
5. To understand the fundamental principles of special arc welding process.
6. To understand the knowledge of plasma arc in metal joining and cutting process.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable welding methods for processindustries
2. Know the materials for processindustries.
3. Apply the knowledge of solid-state welding process for engineering applications.
4. Understand the principles of radiant energy metal joining process.
5. Understand the fundamental principles of special arc welding process.
6. Understand the knowledge of plasma arc in metal joining and cutting process.

UNIT I

Heat exchanges, power cycle piping, super heaters, reheaters, economizer, auxiliary pipes, materials, processes and testing/inspection Materials, processes, fabrication techniques and field welding for pressure vessel applications

UNIT II

Materials, processes, fabrication and construction, use of automatic welding and systems in automobile industry, automation, Oil and gas industry, materials, processes, fabrication, inspection and testing, case studies, recent trends and developments

UNIT III

Materials, processes, fabrication, inspection and testing, reasons for stringent quality control measures in nuclear industry

SUGGESTED READINGS:

1. American Welding Society, ‘Guide for Steel Hull Welding’,1992
2. Gooch T. S., ‘Review of Overlay Welding Procedure for Light Water Nuclear Pressure Vessels’, American Welding Society,1991
3. Winter Mark H., ‘Materials and Welding in Off-Shore Constructions’, Elsevier,1986
4. Welding Institute Canada, ‘Welding for Challenging Environments’, Pergamon Press,1996
5. Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing,ASM,2007

18BEME553B REPAIR WELDINGANDRECLAMATION 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100** External **: ---** Total**:100**

COURSE OBJECTIVES

1. To know the repairprocedures.
2. To learn metallurgical failures andservicing.
3. To understand NDTprocesses
4. To acquire fundamental knowledge on principles of solid state welding processes.
5. To understand the effect of welding parameters on weld quality.
6. To study the importance of advanced welding processes.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable welding techniquerepairing.
2. Know the methods of welding against metallurgicalfailures
3. Acquire practical knowledge on fusion and solid state welding processes.
4. Understand the effect of welding parameters on quality of welded joint.
5. Expertise on using welding software packages.
6. Analyse the experimental results using statistical tools

UNIT I

Engineering aspects of repair, aspects to be considered for repair welding, techno-economics, repair welding procedures for components made of steel casting and cast iron. Half bead, temper bead techniques, usage of Ni base filler metals Damaged bends in gas transmission pipeline, heat exchanger repair techniques-explosive expansion, plugging, etc.

UNIT II

Creep damaged high temperature components, repair of cracked petroleum pressure vessel/reactor Types of wear, wear resistant materials, selection of materials for various wear applications; reclamation surfacing techniques, selection of welding process for reclamation Integrating repair/maintenance into on-going operations.

UNIT III

Radiation protection, steam generator repair, plugging Various types of hardness tests, NDE of surface coatings, characterisation of coatings, photothermal imaging, case histories on selection application/materials combination

Suggested Readings:

1. Dobly R.E., Kent K.S., ‘Repair and Reclamation’, The Welding Institute,1986

2. ‘Maintenance Welding in Nuclear Power Plants’, American Welding Society,1988

18BEME554 WELDINGPROCESSLABORATORY 3 H – 0 C

Instruction hours / week L : 0 T : 0 P:3 **Marks:** Internal **: 100** External **: ---** Total**:100**

COURSE OBJECTIVES

1. To know the concepts of materials joiningtechnology
2. To apply them for the advanced manufacturing processing for various structural engineering applications.
3. Understand the various codes and standards on welding applications.
4. Gain knowledge to apply a specific code for a given welding application
5. Understand the various manual and automated welding processes available.
6. Gain knowledge of the concepts, operating procedures, applications, advantages and limitations of various welding processes

COURSE OUTCOMES

1. Develop basic welding skills in manual arc weldingprocesses
2. Understand the weldmentmicrostructure
3. Analyze the various metallurgical factors affecting mechanical properties of different metals and alloys.
4. Gain knowledge to apply a specific code for a given welding application
5. Understand the various manual and automated welding processes available.
6. Gain knowledge of the concepts, operating procedures, applications, advantages and limitations of various welding processes

List of Experiments: Welding

1. Arc strikingpractice

2. Bead-on-platewelding

3. Effect of welding parameters on weldbead

4. Macrostructure

HAZ, Weldment, Bead Shape pool dimensions, Reinforcement

5. Microstructural observation of weldments

- Carbonsteel
- Stainless stee
- Aluminiumalloy
- Titaniumalloy
- Dissimilarjoints

18BEME555 **PROJECT WORK -I** **1 H – 1 C**

(Course Oriented)

Instruction hours / week L : 0 T : 0 P:1 **Marks:** Internal**:100**External**:---**Total**:100**

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students may be grouped into maximum of 4 students and work under the guidance of the supervisor. A project report to be submitted by the group and the course oriented project working model or demo model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of theDepartment.

SEMESTER – VI

18BEME601 DESIGN OFTRANSMISSIONSYSTEMS 4 H – 4 C

Instruction hours / week L : 3 T : 1 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To Study and acquire knowledge on design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. To Study and acquire knowledge on design spurs and parallel axis helical gears.
3. To give exposure to dimensions for bevel and worm gears.
4. To provide an overview of design procedures of gear boxes for industrial applications.
5. To provide an overview of clutches and brakes for engineering applications.
6. To make the student acquire sound knowledge of mechanical system

COURSE OUTCOMES

Upon completion of this course, the students will able to

1. Design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. Design spurs and parallel axis helical gears.
3. Estimate the dimensions for bevel and worm gears.
4. Practice the design procedures of gear boxes for industrial applications.
5. Design clutches and brakes for engineering applications.
6. Design a mechanical system

UNITI DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLEELEMENTS

Design of V belts and pulleys – Selection of Flat belts and pulleys – Wire ropes and pulleys – Selection of Transmission chains and Sprockets – Design of sprockets.

UNITII DESIGN OF SPUR AND HELICALGEARS

Gear Terminology – Speed ratios and number of teeth–Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width–power rating calculations based on strength and wear considerations – Parallel axis Helical Gears & cross helical gears.

UNITIII DESIGN OF BEVEL AND WORMGEARS

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits– terminology – Thermal capacity, materials–forces and stresses, efficiency, estimating the size of the worm gear pair.

UNITIV DESIGN OF GEARBOXES

Geometric progression – Standard step ratio – Ray diagram, kinematics layout –Design of sliding mesh gear box –Constant mesh gear box. – Design of multi speed gear box.

UNITV DESIGNOFCLUTCHESANDBRAKES

Design of plate clutches –axial clutches–cone clutches–internal expanding rim clutches–internal and external shoe brakes.

(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS

1. Robert C. Juvinall, Kurt M. Marshek, Fundamentals of Machine Component Design, 6th Edition,JohnWiley and Sons., London,2018
2. Bhandari V B, Design of Machine Elements, 4th Edition, Tata McGraw Hill,2016
3. Maitra G.M., Prasad L.V, Hand book of Mechanical Design, 2nd edition, Tata McGraw–Hill, New Delhi,2001
4. Shigley J.E, Mischke C.R, Shigley's Mechanical Engineering Design, 10th edition, McGraw–Hill International Editions, New Delhi,2015
5. Gope P C,Machine Design :Fundamentals And Applications,1st edition,PHIlearning,India,2012.

18BEME641 MANUFACTURINGTECHNOLOGY II 6 H – 5 C

(Theory & Lab)

Instruction hours / week L : 4 T : 0 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To Explain the mechanics of metal cutting, cutting tool materials, tool wear and cutting fluids.
2. To understand the concept of constructional features of different types of lathe and their operations.
3. To provide knowledge on construction & working of shaping, milling &drilling machines and gear cutting & finishing process.
4. To expose students to various types of grinding machines and broaching machines.
5. To Explain the construction features of different types of CNC machine and manual part programming for a given component.
6. To Perform part programming for CNC machines.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Explain the mechanics of metal cutting, cutting tool materials, tool wear and cutting fluids.
2. Discuss about the constructional feature of different types of lathe and their operations.
3. Describe the construction & working of shaping, milling &drilling machines and gear cutting & finishing process.
4. Illustrate the various types of grinding machines and broaching machines.
5. Explain the construction feature of different types of CNC machine and manual part programming for a given component.
6. Perform part programming for CNC machines.

UNIT I THEORY OF METALCUTTING

Mechanics of chip formation, cutting forces during machining, Types of Chips, cutting tools– Single point and multipoint cutting tools : Tool angles and Nomenclature of cutting tools. Orthogonal and Oblique cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish - cutting fluids: Types, characteristics, functions. Machinability: Definition and Factors influencing machinability.

UNITII CONVENTIONAL MACHINETOOLS

Lathes: Working principle, constructional details, specification, operations – Taper turning -Thread cutting methods - Special attachments - Capstan and Turret Lathes – Automats. Construction, working principle and types of operations of: Shaper, Planer, Slotting machine -, Drilling Machine - Milling Machine

UNIT III CNC MACHINING

Numerical Control (NC) machine tools – Computer Numerical Control (CNC) Machines: Types, Constructional details, special features - Machining centre - Part programming fundamentals CNC Manual part programming – micromachining – wafermachining.

UNITIV ABRASIVEPROCESSES

Abrasive Processes: Grinding: Principle of grinding, grinding machine parts, types, grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding - Typical applications – concepts of surface integrity- Broaching machines: Broach construction – push, pull, surface and continuous broaching machines.

UNITV ELECTRICAL AND ELECTRO-CHEMICAL ENERGY BASEDPROCESSES

Electric Discharge Machining (EDM)- Working Principle- EDM equipments parts - electrode / Tool –Dielectric – Flushing – Wire cut EDM – Applications. Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant - techniques of applying maskants - Applications. Principles of ECM- equipments-Surface Roughness and material removal rate. Electrochemical Grinding and Electrochemical Honing - Applications.

SUGGESTED READINGS

1. P.N. Rao, Manufacturing Technology: Vol I, 4th edition, Tata McGraw–Hill Publishing Limited, New Delhi,2013
2. P.C. Sharma, A text book of production technology, 4thEdition, S. Chand and Company, New Delhi,2014
3. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9thedition, John Wiley and Sons, 2005.
4. S K Choudhury, Elements of Workshop Technology Vol– II, 13th edition, Media Promotors Pvt Ltd., Mumbai, 2010
5. Hindustan Machine Tools, Production Technology, 1st edition, Tata McGraw–Hill,2001
6. Steve F. Krar, Arthur R. Gill and Peter Smid, Technology of Machine Tools, 7th edition, Tata McGraw–Hill,2013
7. Milton C. Shaw, Metal Cutting Principles, 2nd edition, Oxford University Press,2004

(ii) Laboratory

COURSE OBJECTIVES

1. To Study and acquire knowledge on various basic machining operations in special purpose machines.
2. To learn applications in real life manufacture of components in theindustry.
3. To learn the Step turning and taper turning and thread cutting Drilling and Tapping on the lathe machine.
4. To perform thread cutting and knurling on a circular C.S rod and using the lathe machine
5. To the operations of Shaping and Planing and milling.
6. To learn the measurement of the Angle and tapers by Bevel protractor, Sine bars, etc

COURSE OUTCOME

Upon completion of this course, the students will be able to

1. Perform shapingoperation
2. Perform milling & slottingoperation
3. Perform drilling, tapping and reamingoperation
4. Perform grindingoperations
5. Work with tool grindingmachine
6. Work in a capstan and turretlathe

LIST OF EXERCISES

1. Exercises inshaping.
2. Exercises inMilling.
3. Exercises inslotting.
4. Exercises in Drilling / Tapping /Reaming.
5. Exercises in Surface grinding and cylindrical grindingprocess.
6. Exercises in Tool grinding – single point and multi pointtools.
7. Exercises in Capstan and TurretLathe.

18BEME642 INDUSTRIALMETROLOGY 5 H – 4 C

Instruction hours / week L : 3 T : 0 P:2 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To provide knowledge on various Metrological equipment available to measure the dimension of the components.
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
3. To enrich the understanding of principles of measuring instruments and gauges
4. To give exposure to inspection of spur gear and thread elements.
5. To equip them with skills to linear measurements using various measuringinstruments
6. To give exposure toprocedures involved in erectingmachineries

COURSE OUTCOMES

Upon completion of this course, the students will able to

1. Understand the basics of measurements and qualitystandards.
2. Perform linear measurements using various measuringinstruments
3. Perform the geometrical measurements of variouscomponents
4. Measure the various dimensions of a screwthread
5. Measure the dimensions of the simple spurgear.
6. Know the procedures involved in erectingmachineries.

UNITI BASICS OF MEASUREMENT, DEVICES AND QUALITYSTANDARDS

Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe's Principle. General cares and rules in measurement, International standardization, SI units and quantities, BIS- NPL – advantages, ISO 9000 quality standards, QS 9000 standards, Environment standards, metrology room measuring standardsroom.

UNITII LINEARMEASUREMENTS

Material length standards –line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector.

UNITIII GEOMETRICALMEASUREMENT

Angular measurement – plain vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gague, Taylor's principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used , specification of surface texture, drawing and symbols, Tomilson surface meter.CMM.

UNITIV METROLOGY OF MACHINE ELEMENTS

Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean roomenvironment.

UNITV MACHINE INSTALLATION ANDTESTING

Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

TEXT BOOKS

1. Jain R.K, Engineering Metrology, 21st edition, Khanna Publishers, Delhi, 2018reprint
2. Alan S. Morris, The Essence of Measurement, 1st edition, Prentice Hall of India, New Delhi,1996
3. N.V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, 1st edition, Oxford University press of India,2013
4. R.K. Jain, Mechanical and Industrial Measurements, 12th edition, Khanna Publishers,1995.
5. J P Holman, Experimental Methods for Engineers, 1st edition, Tata McGraw Hill Education,2007
6. Beckwith T.G and N. Lewis Buck N, Mechanical Measurements, 6thedition,Addison Wesley, New york, 2006

(ii) Laboratory

COURSE OBJECTIVES

1. Inspection of engineering parts with various precision instruments.
2. Design of part, tolerances and fits.
3. Principles of measuring instruments and gauges and their uses.
4. Evaluation and inspection of surface roughness.
5. Inspection of spur gear and thread elements.
6. Machine tool testing to evaluate machine tool quality

COURSE OUTCOMES

1. Students will be able to design tolerances and fits for selected product quality.
2. Students will be able to choose appropriate method
3. Students will be able to instruments for inspection of various gear elements and thread elements.
4. Students will be able to understand the standards of length, angles.
5. Students will be able to can understand the evaluation of surface finish and measure the parts with various comparators.
6. Students will be able to quality of the machine tool with alignment test can also be evaluated by them.

METROLOGY

1. Calibration of Vernier / Micrometer / Dialgauge
2. Checking dimensions of part using slipgauges
3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
4. Measurement of taper angle using sine bar / tool makersmicroscope
5. Measurement of straightness andflatness
6. Measurement of thread parameters
7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic /Electrical)
8. Surface finishmeasurement

18BEME6E__ PROFESSIONAL ELECTIVE–I 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BEME6E__ PROFESSIONAL ELECTIVE–II 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BE_____ OPEN ELECTIVE– II 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BEME611 COMPUTER AIDED MODELING ANDSIMULATION LABORATORY **3 H – 2 C**

Instruction hours / week L : 0 T : 0 P:3 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To gain practical experience in handling 2D drafting and 3D modeling softwaresystems.
2. To impart training on SOLID WORKS for modelling
3. To provide knowledge on assembly ofcomponents
4. To facilitate the understanding of manufacturing drawings from the modelscreated
5. To understand the importanceof MAT Lab for simulating different systems
6. To acquaint the student with the conceptsof mat lab for performing various mathematical operations

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. use computer and CAD software's for modeling of mechanicalcomponents
2. use various options in SolidWorks for modeling of givencomponents
3. create assembly ofcomponents
4. prepare manufacturing drawings from the modelscreated
5. Use MAT Lab for simulating different systems like hydraulic and pneumaticcircuits
6. Use mat lab for performing various mathematicaloperations

COMPUTER AIDED DESIGN

1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend,rib.
2. Assembly – creating assembly from parts – assemblyconstraints
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to SurfaceModeling.
5. Introduction to File Import, Export – DXF, IGES, STL,STEP

Note: Any one of the 3D MODELING software's like SOLIDWORKS, CREO, CATIA, NX Software, AutoCADetc.

COMPUTER AIDED SIMULATION

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP usingSoftware
2. Simulation of Hydraulic / Pneumatic cylinder usingSoftware
3. Simulation of cam and follower mechanism usingSoftware
4. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and twovariables
5. Use of MATLAB to solve simple problems invibration

18BEME651 ROBOTICSANDAUTOMATION 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100** External **: --**Total**:100**

COURSE OBJECTIVES

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions.
3. To develop student's skills in perform kinematics analysis of robot systems.
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
5. To provide the student with some knowledge and analysis skills associated with trajectory planning.
6. To provide the student with some knowledge and skills associated with robot control.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Understand the fundamentals of therobots
2. Describe the robot celldesign
3. Know the safety considerations in roboticapplications.
4. The student with knowledge of the singularity issues associated with the operation of robotic systems.
5. The student with some knowledge and analysis skills associated with trajectory planning.
6. The student with some knowledge and skills associated with robot control.

FUNDAMENTALS OF ROBOT

Robot – Definition – Robot Anatomy – Co–ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications. Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features. End Effectors – Grippers. Requirements of a sensor, Principles and Applications of sensors – Position of sensors, Proximity Sensors, Touch Sensors – Camera, Frame Grabber, Sensing and Digitizing Image.

ROBOT CELL DESIGN

Robot cell design – simulation software (Robo Wave). Robot cell layouts – Multiple robots and machine interference – robot cell planning – robot cycle time analysis for assembly, welding and painting shop.

SAFETY CONSIDERATIONS

Safety Considerations for Robot Operations, Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

SUGGESTED READINGS

1. Klafter R.D., and Negin M, Robotic Engineering - An Integrated Approach, Prentice Hall,2003
2. Groover M.P, Industrial Robotics -Technology Programming and Applications, McGraw Hill,2012

18BEME652A WELDING CODESANDSTANDARDS 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To establish the weldingprocedures.
2. To learn the codes andpractices.
3. To identify welding procedure specifications. Develop welding procedures, and list alloy/phases of metal and the effect of heating and cooling.
4. To identify the welding symbol and weld symbols.
5. To identify both destructive and non-destructive weld test, and identify weld discontinuities.
6. To list responsibilities of inspectors, apply pre-weld, in process, and shop inspections standards.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Establish the weldingprocedures.
2. Learn the codes andpractices.
3. Identify welding procedure specifications. Develop welding procedures, and list alloy/phases of metal and the effect of heating and cooling.
4. Identify the welding symbol and weld symbols.
5. Identify both destructive and non-destructive weld test, and identify weld discontinuities.
6. List responsibilities of inspectors, apply pre-weld, in process, and shop inspections standards.

UNIT I

Design requirements, allowable stress values, workmanship and inspection, introduction to welding codes and standards, AWS D1.1 Process and product standards for manufacturing of pipe - welding procedure and welder qualification, field welding and inspection,

UNIT II

API 1104 and API5L Design requirements, fabrication methods, joint categories, welding and inspection, post weld heat treatment and hydro testing, ASME II, V, VIII and IX Welding procedure specification, procedure qualification records, performance qualification, variables.

UNIT III

Introduction to materials standards and testing of materials, consumables testing and qualification as per ASME/AWS requirements

SUGGESTED READINGS:

1. AWS D1.1 Structural WeldingCode
2. API 5L
3. API 1104
4. ASME Section VIII - Division1
5. ASME SectionIX
6. ASME Section II PartA

18BEME652B WELDINGCONSUMABLES 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To know the consumables in weldingindustry.
2. To know the standards and qualification forconsumables.
3. To escribing safety precautions when using trade-related hand and power tools and equipment
4. To selecting appropriate trade-related equipment for the job
5. To safely operating trade-related equipment to complete specified welding processes efficiently and correctly
6. To employing math concepts to measure thickness and layout materials to complete task

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Know the consumables in weldingindustry.
2. Know the standards and qualification forconsumables.
3. Escribing safety precautions when using trade-related hand and power tools and equipment
4. Selecting appropriate trade-related equipment for the job
5. Safely operating trade-related equipment to complete specified welding processes efficiently and correctly
6. Employing math concepts to measure thickness and layout materials to complete task

UNIT IFLUX COATED ELECTRODES: SMAW electrodes for carbon steels, low alloy steels, stainless steels, Al alloys, Cu alloys, Ni alloys – Classification as per AWS, Requirements of mechanical properties, chemical composition, testing requirements, intended use of important electrodes Problems based on selection of flux coated electrodes based on flux characteristics, material to be welded, properties required / applications. Filler metal qualification as per Section IIC. BARE WELDING ELECTRODES AND RODS: Bare welding electrodes and rods for carbon steels, low alloy steels, stainless steels, Al alloys, Ni alloys, Cu alloys, Ti alloys– Classification as per AWS, Requirements of mechanical properties, chemical composition, testing requirements, intended use of important electrodes. Problems based on selection of bare welding electrodes and rods based on material to be welded, properties required / applications. Filler metal qualification as per SectionIIC.

UNIT IIELECTRODES AND FLUXES FOR SAW AND FLUX CORED ELECTRODES: SAW electrodes for carbon steels, low alloy steels, Fluxes, manufacturing methods, chemical nature; FCAW electrodes for Carbon steels, Low alloy steels, Stainless steels, Ni alloys. Classification as per AWS, Requirements of mechanical properties, chemical composition, testing requirements, intended use of important electrodes. Problems based on selection of electrodes and fluxes based on flux characteristics, material to be welded, properties required / applications. Filler metal qualification as per Section IIC. SURFACING ELECTRODES, CAST IRON ELECTRODES AND RODS: Classification as per AWS, Requirements of mechanical properties, chemical composition, testing requirements, intended use of important electrodes Problems based on selection of electrodes / rods based on material to be welded, properties required / applications. Filler metal qualification as per SectionIIC.

UNIT IIIBRAZING METALS, BRAZING FLUXES, TUNGSTEN ELECTRODES, SHIELDING GASES: Classification as per AWS, intended use, testing requirements, Shielding gases - Types, characteristics, physical properties, shielding properties, applications. Problems based on brazing metals, brazing fluxes, tungsten electrodes, shielding gases based on material to be joined, properties required / applications. Filler metal qualification as per SectionIIC.

SUGGESTED READINGS

1. ASME Boiler and pressure Vessel Code – Part II C – Specifications for Welding Rods, Electrodes and Filler metals, 2013.
2. Larry Jeffus, “Welding principles and applications”, Delmer cengage learning,2012.
3. Lancaster, “Metallurgy of welding”, ELS,2012.
4. Granjon, “Fundamental of welding metallurgy”, Abington,1991.

18BEME653 HEATTREATMENTLABORATORY 3 H – 0 C

Instruction hours / week L : 0 T : 0 P:3 **Marks:** Internal **: 100** External **: --** Total**:100**

COURSE OBJECTIVES

1. To develop the knowledge of heat treatment and associated procedure of various engineeringmaterials
2. apply them to study how it influences the microstructure and results in different mechanical behavior. CourseContent
3. The student will identify six properties of metals; explain the processes by which Iron and Steel are made; and describe the effect of alloying elements on Steel.
4. The student will select the proper grade of tool steel for a workpiece; harden and temper a carbon-steel workpiece; and caseharden a piece of machine steel.
5. The student will explain the three methods of hardness testing; perform a Rockwell C hardness test on a workpiece; Perform Tensile strength and impact tests on a workpiece; Describe several nonferrous metals used in industry.
6. The student will define various terms that apply to metal cutting; explain the flow patterns of metal as it is cut; and recognize the three types of chips produced from various metals.

COURSE OUTCOMES

1. Develop the knowledge of heat treatment and associated procedure of various engineeringmaterials
2. Apply them to study how it influences the microstructure and results in different mechanical behavior. CourseContent
3. The student will identify six properties of metals; explain the processes by which Iron and Steel are made; and describe the effect of alloying elements on Steel.
4. The student will select the proper grade of tool steel for a workpiece; harden and temper a carbon-steel workpiece; and caseharden a piece of machine steel.
5. The student will explain the three methods of hardness testing; perform a Rockwell C hardness test on a workpiece; Perform Tensile strength and impact tests on a workpiece; Describe several nonferrous metals used in industry.
6. The student will define various terms that apply to metal cutting; explain the flow patterns of metal as it is cut; and recognize the three types of chips produced from various metals.

List of Experiments

1. Determination of grain size of low carbonsteels
2. Heat treatment of mild, medium carbon and alloysteels
3. Carburizing ofsteel
4. Heat treatment of toolsteels
5. Heat treatment of stainlesssteels
6. Heat treatment of titaniumalloys
7. Heat treatment of magnesiumalloys
8. Heat treatment of aluminiumalloys
9. Heat treatment of superalloys
10. Microstructural evaluation of nitrocarburisedsteels

18BEME654 MINI PROJECT IIONWELDING 1 H – 0 C

Instruction hours / week L: 1 T : 0 P:0 **Marks:** Internal**: 100** External**: --** Total**:100**

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

18BEME691 PROJECT WORK -II 1 H – 1 C

(Mini Project)

Instruction hours / week L : 0 T : 0 P:1 **Marks:** Internal **: 100**External **: ---**Total**:100**

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students may be grouped into maximum of 4 students and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of theDepartment.

SEMESTER – VII

18BEME741 AUTOMATIONINMANUFACTURING 5H – 4 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To understand the importance of automation in the of field machine tool basedmanufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics andCNC
3. To understand the basics of product design and the role of manufacturingautomation
4. To provide an overview of importance of group technology andFMS
5. To provide knowledge on various inspection technologies to enhance the quality of thesystem
6. To enrich the understanding of various manufacturing supportsystems

COURSE OUTCOMES

Upon completion of this course, the students will

1. Understand the basics and need for automation inmanufacturing
2. Describe the essential requirement of the computers indesign
3. Explain the importance of group technology andFMS
4. Understand the essentiality of qualitycontrol.
5. Apply various inspection technologies to enhance the quality of thesystem.
6. Explain various manufacturing supportsystems.

UNITI MANUFACTURINGOPERATIONS

Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies - Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations

UNITII AUTOMATED MANUFACTURINGSYSTEMS

Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.Components of Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

UNITIII GROUP TECHNOLOGY & FLEXIBLE MANUFACTURINGSYSTEMS

Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

UNITIV QUALITY CONTROL SYSTEMS AND INSPECTIONTECHNOLOGIES

Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering, Introduction to SQC Tools.Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, and Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies.

UNITV MANUFACTURING SUPPORTSYSTEM

Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.

SUGGESTED READINGS:

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing,4th Edition,Pearson EducationLtd,2015
2. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 4th edition,PearsonEducation,2010.
3. YoramKoren, Computer control of manufacturing system, 1st edition,Tata McGraw-HillEducation,2005
4. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition,Tata McGraw-HillEducation,2009

(ii) Laboratory

COURSE OBJECTIVES

1. To study the features of CNC MachineTool.
2. To expose students to modern control systems (Fanuc, Siemensetc.,)
3. To know the application of various CNC machines like CNC lathe, CNC Vertical Machiningcentre.
4. To create part programming involving differentmotions.
5. To understand the working of standard cannedcycles.
6. To generate NC code usingsoftware's

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Create manual part programming for various components using G and Mcodes
2. Expose students to modern control systems (Fanuc, Siemensetc.,)
3. Know the application of various CNC machines like CNC lathe, CNC Vertical Machiningcentre
4. Create part programming involving differentmotions.
5. Understand the working of standard cannedcycles.
6. Generate NC code usingsoftware's

LIST OF EXPERIMENTS

1. MANUAL PART PROGRAMMING (Using G and M Codes) in CNCMachine.
2. Part programming for Linear, Circular interpolation, and Contourmotions.
3. Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, andBoring.
4. NC code generation using software's like Edge CAM, CREO,etc.
5. CNC Controllers like FANUC, Siemens, and Hiedenhainetc.

18BEME742 COMPUTERAIDEDENGINEERING 6 H – 5 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

(i) Theory

COURSE OBJECTIVES

1. To get the knowledge on CAD/CAMsystems.
2. To introduce the students to various techniques in CAD and help them to gain proficiency in developing mathematical models and CNCprogrammes.
3. To understand the concept of finite element method for displacement and nodalforces.
4. To gain knowledge of numerical calculations and computer tools forvalidation.
5. To study the convergence of output results and validate through theoreticalapproach.
6. To introduce the concepts of coding behind working of finite element concepts

COURSE OUTCOMES

Upon completion of this course, the students will

1. Understand geometric transformation techniques inCAD.
2. Develop mathematical models to represent curves and surfaces and model engineering componentsusing solid modelingtechniques.
3. Develop CNC programs to manufacture industrialcomponents.
4. Apply core mechanical concept to provide preliminary results of nodal force and displacement usingFEM.
5. Explain the coding behind working of finite element concept for validation of static structural and thermal analysis.
6. Interpret the results of finite element analysis and make an assessment results in terms of modeling Discretization.

UNIT I INTRODUCTION TO CAD/CAM AND GEOMETRIC MODELING

Introduction to CAD/CAM: Introduction to CAD/CAM/CIM, CAD/CAM input devices, CAD/CAM output devices, CAD/CAM Software. Transformations of geometry - Geometric Modeling of Curves - Geometric Modeling of Surfaces. Geometric Modeling of Solids, CSG approach of solid modeling. Data Exchange Formats andApplications

UNIT II CAM AND CNC

Computer Aided Manufacturing (CAM): Introduction to Computer Numerical Control (CNC), Structure of NC machine tools, Designation of axes, Drives & actuation systems, Feedback devices, CNC tooling, Automatic tool changers & Work holding devices. CNC Programming: Part programming fundamentals, Manual Part Programming, APT Programming, Geometric & motion commands, Post processor commands.

UNIT III INTRODUCTION TO FEM

Historicalbackground–Matrixapproach–Applicationtothecontinuum–Discretization–Matrixalgebra–
Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritzmethod

UNIT IV ONE AND TWO DIMENSIONAL PROBLEMS

One Dimensional problems: Finite element modeling – Coordinates and shape functions– Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses. Two Dimensional problems: Poisson equation – Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galerkin approach – Stress calculation – Temperature effects.

UNIT V AXISYMMETRIC AND ISOPARAMETRIC CONTINUUM

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications. Isoparametric formulation: The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Stress calculations – Four node quadrilateralelement.

SUGGESTED READINGS:

1. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition, Tata McGraw-HillEducation,2009
2. Rao S.S, The Finite Element Method in Engineering, 4th Edition, Butter worth Heinemann imprint, USA, 2011
3. Daryl L. Logan, A First course in the Finite Element Method, 5th Edition, Cengage Learning, Stamford, USA,2011
4. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering: International Edition, 4th Edition, Pearson Education Limited,2014
5. David V Hutton, Fundamentals of Finite Element Analysis, 1st Edition, Tata McGraw–Hill Education, 2005

(ii) Laboratory

COURSEOBJECTIVES

1. To perform simple structural analysis and thermal analysis using simulation software's.
2. To perform structural analysis of bars andtrusses.
3. To perform structural analysis of beams andframes.
4. To perform 2D analysis of plate andshells
5. To perform modal analysis of simplesystems
6. To perform thermal analysis of simplesystems

COURSE OUTCOMES

Upon completion of this course, the Students will be able to

1. Perform structural analysis of bars andtrusses
2. Perform structural analysis of beams andframes
3. Perform 2D analysis of plate andshells
4. Perform modal analysis of simplesystems
5. Perform thermal analysis of simplesystems
6. Perform fluid and failure analysis of simplesystems

LIST OF EXPERIMENTS
(Simple Analysis using ANSYS Tool)

1. Structural Analysis (Static)
   1d and 2d analysisof
   - Bar andtruss,
   - Beams &frames,
   - Plate and shellstructures
2. Structural vibration analysis(Dynamic)
   - Modalanalysis
   - Frequency responseanalysis
   - Transient responseanalysis
3. Thermal analysis – simpleproblems
4. Fluid Analysis – simple problems
5. Failure analysis – simpleproblems

18BEME7E__ PROFESSIONAL ELECTIVE–III 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BEME7E__ PROFESSIONAL ELECTIVE–IV 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BEME7E__ PROFESSIONAL ELECTIVE–V 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BE_____ OPEN ELECTIVE– III 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

18BEME751 MOTORSANDPUMPS 1 H – 0 C

Instruction hours / week L : 1 T : 0 P:0 **Marks:** Internal **: 100**External**: -----**Total**:100**

COURSE OBJECTIVES

1. To understand the working principles ofpumps
2. To understand the working principles andmotors
3. To develop the system curve
4. To calculate the Net Positive Suction Head
5. To calculate the pump Total Head versus Rate of Flow characteristic
6. To match pumps to variable, parallel and series pumping systems

COURSE OUTCOMES

1. Understand the working principles ofpumps.
2. Understand the working principles andmotors.
3. Develop the system curve.
4. Calculate the Net Positive Suction Head.
5. Calculate the pump Total Head versus Rate of Flow characteristic.
6. Match pumps to variable, parallel and series pumping systems.

UNITI SINGLE PHASE INDUCTIONMOTOR

Constructional details of single phase induction motor – Principle of operation – Types – Losses and Efficiency – Performance analysis – Starting methods of single–phase induction motors. – Design aspects of motors for usage in submersible pumps– Motors Rating and selectioncriteria.

UNITII THREE PHASE INDUCTIONMOTOR

Constructional details – Types of rotors – Principle of operation – Need for starters – Types of starters – DOL, Stator resistance and reactance, rotor resistance, autotransformer and star–delta starters – Speed control – Change of voltage, torque, number of poles and slip – Losses and Efficiency – Performance analysis – Design aspects of motors for usage in submersible pumps – Motors Rating and selection criteria.

UNITIII PUMPS

Pumps: definition and classifications – Sewage, fire fighting and Pressure boosting pumpsClassification, working principle, indicator diagram, work saved by air vessels and performance curves – cavitations in pumps – rotary pumps: working principles of gear and vane pumps

SUGGESTED READINGS

1. Kothari, D. P., and Nagrath, I. J, Electric Machines, Tata McGraw Hill Publishing Company Ltd., New Delhi,2014
2. Bimbhra, P. S, Electrical Machinery, Khanna Publishers, New Delhi,2003

18BEME752A DESIGN ASPECTS OF WELDINGANDCASTING 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100**External**:------**Total**:100**

COURSE OBJECTIVES

1. To identify how basic requirements of welding are fulfilled in welding processes and connect with the physical features.
2. To illustrate behavior of welding arc and appraise effect of arc welding process variables on bead parameters and develop arc welding procedure for given job.
3. To choose a suitable welding process for a given welding application.
4. To choose an appropriate method to produce directional solidification in the casting.
5. To illustrate causes of casting defects and its remedies and illustrate casting design considerations.
6. To illustrate capabilities and applications of casting processes

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Identify how basic requirements of welding are fulfilled in welding processes and connect with the physical features.
2. Illustrate behavior of welding arc and appraise effect of arc welding process variables on bead parameters and develop arc welding procedure for given job.
3. Choose a suitable welding process for a given welding application.
4. Choose an appropriate method to produce directional solidification in the casting.
5. Illustrate causes of casting defects and its remedies and illustrate casting design considerations.
6. Illustrate capabilities and applications of casting processes.

UNIT I

Designing for economical moulding – designing for sand moulding – investment castings. Design for economical coring – general rules for designing cored holes. Design problems involving thin sections, uniform sections unequal sections. Dimensional variations and tolerances – influence of cores – influence of location of cores. Dimensions for inspection and machining. Surface finish ISI specification Considering metal flow, riser location, feed path, mould-metal temperature effect. Design problems involving junctions, distortion – possible design remedies. effect of mould material, parting line, fillet influences. Design of gating and risering for ferrous and non-ferrous metals

UNIT II

Types of joints, joint efficiency, edge preparation, types of loads, design for static lading, design for cyclic loading, rigid structures, primary and secondary welds, treating a weld as a line, structural tubular connections, influence of specifications on design, symbols for welding and inspection, estimating and control of welding costs. Residual stresses, causes and effects, methods to measure residual stresses, weld distortion.

UNIT III

Boiler and pressure vessel codes, structural welding codes, pipelines codes. Welding procedure specifications, welding procedure qualifications, welder performance qualifications, welding variables, filler metal qualifications, qualification of welding inspectors, welding supervisors and welding engineers, qualification of NDT personnel.

SUGGESTED READINGS:

1. “Casting.Design Hand Book” , American Society forMetals,1962
2. Matousek R., “EngineringDesign”.,Blackwell ScientificPublications.,1962
3. Heine, Loper and Rosenthal, “Principles of Metal Casting”, Tata McGraw Hill PublishingCo,1995.
4. Harry Peck, “Designing for Manufacture”, Pitman Publications,1983.

18BEME752B DESIGNOFWELDMENTS 2 H – 0 C

Instruction hours / week L : 2 T : 0 P:0 **Marks:** Internal **: 100**External**:------**Total**:100**

COURSE OBJECTIVES

1. To identify how basic requirements of welding are fulfilled in welding processes and connect with the physical features.
2. To illustrate behavior of welding arc and appraise effect of arc welding process variables on bead parameters and develop arc welding procedure for given job.
3. To choose a suitable welding process for a given welding application.
4. To choose an appropriate method to produce directional solidification in the casting.
5. To illustrate causes of casting defects and its remedies and illustrate casting design considerations.
6. To illustrate capabilities and applications of casting processes

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Identify how basic requirements of welding are fulfilled in welding processes and connect with the physical features.
2. Illustrate behavior of welding arc and appraise effect of arc welding process variables on bead parameters and develop arc welding procedure for given job.
3. Choose a suitable welding process for a given welding application.
4. Choose an appropriate method to produce directional solidification in the casting.
5. Illustrate causes of casting defects and its remedies and illustrate casting design considerations.
6. Illustrate capabilities and applications of casting processes.

UNIT I

Type of joints, joint efficiency, factor of safety, symbols, selection of edge preparation, design considerations. Types of loading Permissible stress, allowable defects, computation of stresses in welds, weld size calculation, code requirement for statically loaded structures

UNIT II

Design for fluctuating and impact loading - dynamic behaviour of joints - stress concentrations - fatigue analysis - fatigue improvement techniques - permissible stress- life prediction Concept of stress intensity factors - LEFM and EPFM concepts. Brittle fracture- transition temperature approach - fracture toughness testing, application of fracture mechanics to fatigue Welding residual stresses - causes, occurrence, effects and measurements - thermal and mechanicalrelieving.

UNIT III

Types of distortion - factors affecting distortion - distortion control methods - prediction - correction, jigs, fixtures and positioners.

Suggested Readings:

1. Omer W. B., ‘Design of Weldments’, James.F. Lincoln Arc Welding Foundation,1991
2. Gray T. G. E. ‘Rational Welding Design’, Butterworths,1982
3. Hertzberg R.W., ‘Deformation and Fracture of Mechanics of Engineering Materials’, John Wiley,1996
4. Dieter G.,‘Mechanical Metallurgy’, Tata McGraw Hill,1988
5. Bhattacharya.M, ‘Weldment Design’,Association ofEngineers,1991

18BEME753 WELDINGSIMULATIONLABORATORY 3 H – 0 C

Instruction hours / week L: 0 T: 0P:3 **Marks:** Internal**:100**External**: ------**Total**:100**

COURSE OBJECTIVES

1. To know the consumables in weldingindustry.
2. To know the standards and qualification forconsumables.
3. To escribing safety precautions when using trade-related hand and power tools and equipment
4. To selecting appropriate trade-related equipment for the job
5. To safely operating trade-related equipment to complete specified welding processes efficiently and correctly
6. To employing math concepts to measure thickness and layout materials to complete task

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Know the consumables in weldingindustry.
2. Know the standards and qualification forconsumables.
3. Escribing safety precautions when using trade-related hand and power tools and equipment
4. Selecting appropriate trade-related equipment for the job
5. Safely operating trade-related equipment to complete specified welding processes efficiently and correctly
6. Employing math concepts to measure thickness and layout materials to complete task

Ex.No.1. Process physical simulation Mathematical Modeling –

Ex No: 2: Thermal cycle's simulation studies on weldments using ANSYS

Ex.No: 3 usage of expert systems in welding processes

Ex.No: 4 Artificial intelligence and welding

Ex.No: 5 Solidification studies and microstructure formation

Ex.No: 6. Weld simulator and weld skill development

18BEME754	MINI PROJECT – III ONWELDING	1 H – 0 C
Instruction hours / week L: 1 T: 0P:0	**Marks:** Internal**:100**External**: ------**Total**:100**	

18BEME791	PROJECT-III	6 H – 3 C
Instruction hours / week L : 0 T : 0 P:6	**Marks:** Internal **: 100** External **: --**Total**:100**	

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students in a group consisting of maximum of 4 students works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The project work carried out in this semester may be a standalone project or part of the work of project work –V carried out in the eighth semester.

SEMESTER – VIII

18BEME8__ PROFESSIONAL ELECTIVE–VI 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

18BE_____ OPEN ELECTIVE-IV 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

18BE_____ OPEN ELECTIVE– V 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

18BEME891 PROJECT-IV 12 H – 6 C

Instruction hours / week L : 0 T : 0 P:12 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students in a group consisting of maximum of 4 student's works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of theDepartment.

PROFESSIONAL ELECTIVE I

18BEME6E01 **EMERGINGMATERIALS** **3 H – 3C**

Instruction hours / week L : 3 T : 0 P: 0 **Marks:** Internal **: 40** External **: 60**Total**:100**

End Semester Exam : 3Hours

COURSE OBJECTIVES

1. To describe various processing techniques of different engineeringmaterials.
2. To analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. To describe the metallurgical aspects of aluminium, magnesium and titaniumalloys.
4. To get basic knowledge on super alloys and itsapplications
5. To get basic understanding of nano materials, shape memory alloys andbiomaterials.
6. To select the material for Biological, Nuclear, Space and Cryogenic serviceapplications.

COURSE OUTCOMES

Upon completion of this course, the students can

1. Describe various processing techniques of different engineeringmaterials.
2. Analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. Describe the metallurgical aspects of aluminium, magnesium and titaniumalloys.
4. Get basic knowledge on super alloys and itsapplications
5. Get basic understanding of nano materials, shape memory alloys andbiomaterials.
6. Select the material for Biological, Nuclear, Space and Cryogenic serviceapplications.

UNITI CRYSTALLINEALLOYS

Techniques of rapid solidification. Production of metallic glasses, atomic arrangement, comparison with crystalline alloys - mechanical, electrical, magnetic, superconducting and chemical properties and applications

UNITII STAINLESSSTEEL

Phase diagrams of ferritic, martensitic and austenitic stainless steels, duplex stainless steels, precipitation hardenable stainless steels, mechanical and metallurgical properties of stainless steels, HSLA steels, micro-alloyed steels

UNITIII ALLOYS OF ALUMINIUM, MAGNESIUM &TITANIUM

Aluminium alloys, magnesium alloys and titanium alloys; metallurgical aspects, mechanical properties and applications

UNITIV SUPERALLOYS

Development of super alloys-iron base, nickel base and cobalt base - properties and their applications; materials for cryogenic service, materials in nuclear field, materials used inspace

UNITV ADVANCEDMATERIALS

Carbonaceous materials - including nano tubes and fullerenes; shape memory alloys, functionally gradient materials, high temperature super conductors - bio materials

SUGGESTED READINGS

1. SukhDevSehgal, Lindberg R.A., 'Materials, their Nature, Properties and Fabrication',1st ecition, S Chand, 1975.

2. Ian Polmear, David StJohn, Jian-Feng Nie,'Light alloys: Metallurgy of Light Metals', 5th Edition, Butterwoth-Heinemann,2017.

18BEME6E02 **RENEWABLEENERGYSOURCES** **3 H – 3C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To explainimportance of renewable energy resources.
2. To understand the importance of basic concepts of solar radiation and analyze the working of solar PVand thermal systems.
3. To understand the importance of principles of energy conversion from alternate sources.
4. To understand the importance of wind,geothermal, ocean, biomass, biogas and hydrogen.
5. To study the features ofdesign principles of biogas plants.
6. To understand the concepts and applications of fuel cells, thermoelectric convertor andMHD generator.

To give exposure to power plants working with non-conventional energy.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Understand the importance of renewable energy resources.
2. Understand the basic concepts of solar radiation and analyze the working of solar PVand thermal systems.
3. Understand principles of energy conversion from alternate sources.
4. Understand the importance of wind,geothermal, ocean, biomass, biogas and hydrogen.
5. Implement design principles of biogas plants.
6. Understand the concepts and applications of fuel cells, thermoelectric convertor andMHD generator.

UNITI ENERGY AND ENVIRONMENT

Primary energy sources – world energy resources–Indian energy scenario–energy cycle of the earth – environmental aspects of energy utilization, CO_2 emissions and Global warming–renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

UNITII SOLARENERGY

Principles of solar energy collection – solar radiation – measurements – instruments – data and estimation– types of collectors – characteristics and design principles of different type of collectors – performance of collectors – testing of collectors. Solar thermal applications – water heaters and air heaters – performance and applications – simple calculations – solar cooling – solar drying – solar ponds – solar tower concept – solar furnace.

UNITIII WIND, TIDAL AND GEO THERMALENERGY

Energy from the wind – general theory of windmills – types of windmills – design aspects of horizontal axis windmills – applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants – power from geothermal energy – principle of working of geothermal power plants.

UNITIV BIOENERGY

Energy from bio mass and bio gas plants –various types – design principles of biogas plants – applications. Energy from wastes – waste burning power plants – utilization of industrial and municipal wastes – energy from the agricultural wastes.

UNITV OTHER RENEWABLE ENERGYSOURCES

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermoelectric generators – thermionic generators – fuel cells – solar cells – types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

SUGGESTED READINGS

1. R K Bansal, A Non-Conventional Energy sources, 1st edition, Vikas Publishing house, New Delhi,2014
2. John A. Duffie, William A. Beckman, Solar Engineering of Thermal Processes, 4thEdition, John Wiley & Sons, Inc , 2013
3. S. P. Sukhatme and J K Nayak, Solar Energy: Principles of Thermal Collection and Storage, 3rd edition, Tata McGraw Hill, New Delhi,2008
4. Garg. H. P and Prakash J, Solar Energy - Fundamentals and applications, 8thedition,Tata McGraw-Hill Publishing Company,2007.
5. Ashok V Desai, Non–conventional Energy, 1st edition, New Age International (P) Ltd.,2011

18BEME6E03 **INDUSTRIALROBOTICS** **3 H – 3C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the anatomy, basic concepts and applications ofrobot.
2. To learn the drives and end effectors used inrobot.
3. To study the various types of sensors used inrobot.
4. To familiarize robot kinematics and robotprogramming
5. To provide knowledge onsimple offline robot program
6. To impart knowledge on economic analysis ofrobots

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Identify the various types ofrobots.
2. Select appropriate drive systems and end effectors for industrialapplication.
3. Decide the types of sensors required according to the applications ofrobot.
4. To identify the different types of machine visiontechnologies
5. Develop simple offline robot program for differentapplications.
6. Calculate the economic analysis ofrobots.

UNIT I FUNDAMENTALS OFROBOT

Robot – Definition – Robot Anatomy – Co–ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications

UNITII ROBOT DRIVE SYSTEMS AND END EFFECTORS

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives

End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III SENSORS AND MACHINEVISION

Requirements of a sensor, Principles and Applications of the following types of sensors – Position sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors

Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNITIV ROBOT KINEMATICS AND ROBOTPROGRAMMING

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems.

Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

UNITV IMPLEMENTATION AND ROBOT ECONOMICS

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method, Process application of Robots and Collaborative robots.

SUGGESTED READINGS

1. NicholasO,MitchellW,MikellGroover,RogerNNagelandAshishDutta,IndustrialRobotics– Technology Programming and Applications, 2nd edition, McGraw–Hill, New Delhi, 2012
2. Fu.K.S., Gonzalz.R.C. and Lee C.S.G, Robotics Control, Sensing, Vision and Intelligence, 1st edition, McGraw–Hill Book Co., New Delhi,2008
3. Yoram Koren, Robotics for Engineers, 1st edition, McGraw–Hill Book Co., New Delhi,2007
4. Janakiraman. P.A, Robotics and Image Processing: An Introduction, 1st edition, Tata McGraw–Hill, New Delhi,1995.

18BEME6E04 **ADVANCED I.C.ENGINES** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the underlying principles of operation of different IC Engines andcomponents.
2. To provide knowledge on pollutant formation, control, alternate fueletc.
3. To Study and acquire knowledge to Identify parts, terminology and fuel supply system of internal combustionengine
4. To introduce the concepts of cooling and lubrication systems of ICengines
5. To make the student acquire sound knowledge on combustion, knocking and super charging of internal combustionengines
6. To expose students to recent trends associated with ICengines

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Explain the construction and operation of internal combustionengine.
2. Identify parts, terminology and fuel supply system of internal combustionengine.
3. Recognize the component used in cooling and lubrication systems of ICengines.
4. Describe the function of combustion, knocking and super charging of internal combustionengines.
5. Implement strategies for pollution control.
6. Know about the recent trends associated with ICengines

UNITI SPARK IGNITIONENGINES

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

UNITII COMPRESSION IGNITIONENGINES

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

UNITIII POLLUTANT FORMATION ANDCONTROL

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Drivingcycles.

UNITIV ALTERNATIVEFUELS

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - EngineModifications.

UNITV RECENTTRENDS

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - OnboardDiagnostics.

SUGGESTED READINGS

1. John Heywood, Internal Combustion Engine Fundamentals, 1st edition, Tata McGraw Hill Education, 2011.
2. V Ganesan, Internal Combustion Engines, 4th edition, Tata McGraw Hill Education,2012
3. Mathur. R.B. and R.P. Sharma, Internal Combustion Engines, Dhanpat Rai & Sons,2007
4. Duffy Smith, Auto Fuel Systems, 1st edition, The Goodheart Willcox Company, Inc., 2011(Digital)
5. Eric Chowenitz, Automobile Electronics, 1st edition, Newnes Publications,1995.

18BEME6E05 HYDRAULICS AND PNEUMATICSPOWERCONTROL 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To recognize symbols and fundamentals in fluid power generation anddistribution.
2. To identify power source for hydraulicsystems.
3. To select appropriate components used in various hydraulicsystems.
4. To design hydraulic circuits for givenapplications
5. To distinguish the components used in pneumaticcircuits.
6. To create the logic circuits for controlling electro-hydraulic/ pneumaticsystems.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Recognize symbols and fundamentals in fluid power generation anddistribution.
2. Identify power source for hydraulicsystems.
3. Select appropriate components used in various hydraulicsystems.
4. Design hydraulic circuits for givenapplications
5. Distinguish the components used in pneumaticcircuits.
6. Create the logic circuits for controlling electro-hydraulic/ pneumaticsystems.

UNITI FLUID POWER SYSTEMS ANDFUNDAMENTALS

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics–Applications of Pascals Law– Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves andfittings.

UNITII HYDRAULIC SYSTEM ANDCOMPONENTS

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, Pressure boosting pumps, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors, Rotary distributor.

UNITIII DESIGN OF HYDRAULICCIRCUITS

Construction of Control Components : Direction control valve – 3/2 way valve – 4/2 way valve – Shuttlevalve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications ofIntensifier – Intensifier circuit.

UNITIV PNEUMATIC SYSTEMS ANDCOMPONENTS

Pneumatic Components: Properties of air – Compressors – Filter, Regulator and Lubricator UNIT Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNITV DESIGN OF PNEUMATICCIRCUITS

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

SUGGESTED READINGS

1. Anthony Esposito, Fluid Power with Applications, 1st edition, Pearson Education, New Delhi,2013
2. Majumdar S. R, Oil Hydraulic Systems: Principles and Maintenance, 1st edition, Tata McGraw–Hill, New Delhi,2000.
3. IlangoSivaraman, Introduction To Hydraulics And Pneumatics, 3rdedition,, PHI Learning Pvt. Ltd, New Delhi,2017.
4. Michael J, Prinches and AshbyJ.G, Power Hydraulics, 1st edition, Prentice Hall of India, New Delhi, 2007 (digital)

18BEME6E06 **AUTOMOBILEENGINEERING** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the student acquire sound knowledge on the types of vehicle structures, cooling and lubrication systems required.
2. To acquaint the student with the concepts of type of engines to be used for modern automobiles.
3. To familiarize the students to Distinguish between the manual transmissions systems with automatic transmission systems.
4. To provide knowledge on appropriate transmission systems for the optimal power transmission.
5. To provide knowledge on steering, brakes and suspension systems for effective functioning.
6. To acquaint the student with advanced technologies in automotive Engineering.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Identify the types of vehicle structures, cooling and lubrication systems required.
2. Determine the type of engines to be used for modern automobiles.
3. Distinguish between the manual transmissions systems with automatic transmission systems.
4. Select appropriate transmission systems for the optimal power transmission.
5. Select steering, brakes and suspension systems for effective functioning.
6. Implement the advanced technologies in automotive.

UNITI AUTOMOBILE ARCHITECTURE ANDPERFORMANCE

Automotive components, subsystems and their positions – Chassis, frame and body, front, rear and four wheel drives – Operation and performance – Traction force and traction resistance, Power required for automobile– Rolling, air and gradient resistance.

UNITII TYPES OFENGINES

Types of engines – multi valve engine – in–line engine, vee–engine, Petrol engine–direct – single point and multipoint injection, diesel engine–common rail diesel injection, supercharging and turbo charging – alternate fuels–ethanol and ethanol blend, compressed natural gas, fuel cells,hybrid vehicles**.**

UNITIII TRANSMISSIONSYSTEMS

Clutch :Types – coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box :Types – constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.

UNITIV WHEEL AND TYRES AND SUSPENSIONSYSTEM

Types of wheels, construction, wired wheels, Tyres– construction, Radial, bias and belted bias, slip angle, Tread patterns, Tyre retreading - cold and hot, Tubeless tyres, Types–front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems – Balancing of Wheels.

UNITV STEERING SYSTEM AND BRAKINGSYSTEM

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry–caster, camber, toe–in, toe out etc., wheel Alignment. Braking System – Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc and Drum brakes, Engine brakes and Anti lock braking system.

SUGGESTED READINGS

1. Sudhir Kumar Saxena, Automobile Engineering, 1st edition, Laxmi Publications, Chennai,2015.
2. Dr. KirpalSingh, Automobile Engineering Vol–I and II, 14th edition, Standard publishers, Delhi,2019
3. Julian Happian Smith, An introduction to modern vehicle design, 1st edition, Butterworth Heinemann, New Delhi,2001.
4. Crouse W H, Automotive transmissions and power trains, 6th edition, McGraw–Hill International Editions, New Delhi, 2007(Digital)
5. Heniz Heisler, Vehicle and Engine Technology, 2nd edition, Arnold,2002.

PROFESSIONAL ELECTIVE II

18BEME6E07 DESIGN OF JIGS, FIXTURES ANDPRESSTOOLS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart knowledge on the principles of locating and clamping devices in machining process.
2. To familiarize the students to understand design of jigs for a given component.
3. To Study and acquire knowledge on design fixtures for a given component.
4. To make the student acquire sound knowledge on appropriate type of press tool for a given component.
5. To expose students to drawing die for a given component.
6. To give exposure to the use computer aids for sheet metal forming analysis

COURSE OUTCOMES

Upon the completion of this course the students will be able to

1. Summarize the principles of locating and clamping devices in machining process.
2. Design jigs for a given component.
3. Design fixtures for a given component.
4. Design an appropriate type of press tool for a given component.
5. Develop a drawing die for a given component.
6. Use computer aids for sheet metal forming analysis

UNITI PURPOSE TYPES AND FUNCTIONS OF JIGS ANDFIXTURES

Tool design objective – Production devices – Inspection devices – Materials used in Jigs and Fixtures – Types of Jigs – Types of Fixtures–Mechanical actuation–pneumatic and hydraulic actuation–Analysis of clamping force–Tolerance and error analysis.

UNITII JIGS

Drill bushes –different types of jigs–plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs–Automatic drill jigs–Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for givencomponents.

UNITIII FIXTURES

General principles of boring, lathe, milling and broaching fixtures– Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures– Modular fixtures, Quick change fixtures. Design and development of fixtures for given component.

UNITIV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT

Press working terminology–Presses and press accessories–Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies:Die block–die shoe. Bolster plate–punch plate–punch holder–guide pins and bushes – strippers – knockouts–stops –pilots–Selection of standard die sets strip lay out–strip lay out calculations, SMEDtechnique.

UNITV DESIGN AND DEVELOPMENT OFDIES

Design and development of progressive and compound dies for Blanking and piercing operations. Tool and DIE Materials, Bending dies – development of bending dies–forming and drawing dies–Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

SUGGESTED READINGS

1. Edward G Hoffman, Jigs and Fixture Design, 5th edition, Thomson – Delmar Cengage Learning, Singapore,2012
2. Cyril Donaldson, George H. Lecain and V. C. Goold, Tool Design, 4th edition, Tata McGraw–Hill, New Delhi,2012
3. K. Venkataraman, Design of Jigs, Fixtures and Press Tools, 1st edition, John Wiley & Sons,2015.
4. Joshi P.H, Jigs and Fixtures, 3rd edition, Tata McGraw–Hill Publishing Company Limited, New Delhi, 2010
5. Hiram E Grant, Jigs and Fixtures: Non-Standard Clamping Devices, 1stedition, Tata McGraw–Hill, New Delhi,1971

18BEME6E08 REFRIGERATION ANDAIRCONDITIONING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the underlying principles of operations in different Refrigeration & Air conditioning systems andcomponents.
2. To provide knowledge on design aspects of Refrigeration & Air conditioningsystems
3. To introduce the concepts on use of unconventional refrigerant system for industrialapplication
4. To expose students to properties of air using psychrometricchart
5. To provide knowledge on cooling load for a givensystem
6. To know the application of air conditioning system for industrial and domestic purpose

COURSE OUTCOMES

Learners should be able to

1. Calculate COP of various refrigerationcycles.
2. Choose appropriate refrigerants for variousapplications.
3. Identify the use of unconventional refrigerant system for industrialapplication.
4. Calculate the properties of air using psychrometricchart.
5. Calculate cooling load for a givensystem
6. Select the appropriate air conditioning system for industrial and domesticapplications.

UNIT I REFRIGERATIONCYCLE

Review of thermodynamic principles of refrigeration. Concept of refrigeration system. Vapour compression refrigeration cycle – use of P–H charts – multistage and multiple evaporator systems – cascade system – COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system

UNIT II REFRIGERANTS, SYSTEM COMPONENTS ANDBALANCING

Compressors – reciprocating and rotary (elementary treatment.) – Condensers – evaporators – cooling towers. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls – testing and charging of refrigeration units. Balancing of system components. Applications to refrigeration systems – ice plant – food storage plants – milk –chilling plants – refrigerated cargo ships.

UNITIII PSYCHROMETRY

Psychrometric processes– use of psychrometric charts – – Grand and Room Sensible Heat Factors – bypass factor – requirements of comfort air conditioning – comfort charts – factors governing optimum effective temperature, recommended design conditions and ventilation standards

UNITIV COOLING LOADCALCULATIONS

Types of load – design of space cooling load – heat transmission through building. Solar radiation –infiltration –internalheatsources(sensibleandlatent)–outsideairandfreshairload–estimationoftotalload–
Domestic, commercial and industrial systems – central air conditioning systems.

UNIT V AIRCONDITIONING

Air conditioning equipments – air cleaning and air filters – humidifiers – dehumidifiers – air washers – condenser – cooling tower and spray ponds – elementary treatment of duct design – air distribution system. Thermal insulation of air conditioning systems. – Applications: car, industry, stores, and public buildings

SUGGESTED READINGS

1. Manohar Prasad, Refrigeration and Air Conditioning, 3rd edition, New Age International Ltd, New Delhi, 2015.
2. Arora. C.P, Refrigeration and Air Conditioning, 3rd edition, Tata McGraw–Hill, New Delhi,2008
3. Roy.JDossat, Principles of Refrigeration, 4th edition, Prentice Hall of India PVT Ltd., New Delhi,1998
4. Jordon and Prister, Refrigeration and Air Conditioning, 2nd edition, Prentice Hall of India PVT Ltd.,New Delhi,1982
5. StoeckerN.W and Jerold W.Jones, Refrigeration and Air Conditioning, 2nd edition, McGraw Hill, New Delhi,2007

18BEME6E09 ADVANCEDMANUFACTURINGPROCESSES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide knowledge on different aspects of powder metallurgy parameters.
2. To understand the importance of principle of advanced welding processes and its application.
3. To understand the importance of advanced forming processes and its application.
4. To familiarize the students to advanced manufacturing process for processing of different materials.
5. To acquaint the student to apply the suitable rapid prototyping mechanism for industry need.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

1. Understand different aspects of powder metallurgy parameters.
2. Understand basic principle of advanced welding processes and its application.
3. Understand basic principle of advanced forming processes and its application.
4. Select the best suitable advanced manufacturing process for processing of different materials.
5. Apply the suitable rapid prototyping mechanism for industry need.
6. Select the optimum parametric for advanced manufacturing process.

UNITI POWDER METALLURGYPROCESS

Introduction to powder metallurgy process – preparation of powders – types and functions of binders – green compaction – sintering process and its effect on the product.

UNITII ADVANCED WELDINGPROCESSES

Percussion Welding– Electro Slag Welding, Plasma Arc Welding – Thermit Welding – Electron Beam Welding – Friction and Inertia Welding – Friction Stir Welding – Under Water WeldingProcess.

UNITIII SHEET METAL AND FORMINGPROCESS

Sheet metal process –Laser welding and Cutting, Working principle and application of special forming process – Hydro Forming– Rubber Pad Forming– Explosive Forming – Magnetic Pulse Forming– Peen Forming – Super Plastic Forming – Deep Drawing Process.

UNITIV ADVANCED MACHININGPROCESS

Modern machining process: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electro chemical Machining, Electro chemical Grinding, Electro Discharge Machining, wire cut EDM, Electron Beam Machining, plasma arc machining, Laser Beam Machining. Ultrasonic Machining, High speed machining process – deep hole drilling process

UNITV RAPIDPROTOTYPING

Introduction to Rapid Prototyping – Need for RPT– Stereo–lithography – Selective Laser Sintering, Fused Deposition Modeling, Laminated Object Manufacturing, Solid Ground Curing, Ballistic Particle Manufacturing

SUGGESTED READINGS

1. SeropeKalpakjianSteven R. Schmid, Manufacturing process for engineering materials, 2nd Edition, Pearson Education, Inc,2009
2. O. P. Khanna, A Textbook of Welding Technology, 1st edition, Dhanpat Rai Publications Pvt Ltd,2012
3. P.N. Rao, Manufacturing technology Volume I, 4th edition, Tata McGraw Hill Education,2013
4. Singh, M.K, Unconventional Manufacturing Process, 1st edition, New age international,2019.
5. Vijay.K Jain, Advanced Machining Processes, 1st edition, Allied Publishers Pvt. Ltd,2009

18BEME6E10 VIBRATION ANALYSISANDCONTROL 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the Fundamentals of Vibration and its practicalapplications
2. To understand the working principle and operations of various vibrations Measuringinstruments.
3. To understand thethe importance of vibrationisolation
4. To understand the various Vibration controlstrategies
5. To equip them with skills to solve mathematically a multi-degree freedom system & continuoussystem
6. To give exposure to the various experimental methods used for vibrationanalysis

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Define the terms involved in vibrationsystem.
2. Describe the importance of vibrationisolation
3. Explain the working nature of two degree of freedomsystems
4. Solve mathematically a multi-degree freedom system & continuoussystem
5. List the various techniques used in vibrationcontrol
6. Explain the various experimental methods used for vibrationanalysis.

UNITI FUNDAMENTALS OFVIBRATION

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers -.Response To Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads-Critical Speed Of Shaft-Rotor systems.

UNITII TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped And Damped- Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates.

UNITIII MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUSSYSTEM

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method -Geared Systems-Eigen Values and Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams.

UNITIV VIBRATIONCONTROL

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active VibrationControl.

UNITV EXPERIMENTAL METHODS IN VIBRATIONANALYSIS

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response - Testing for resonance and mode shapes.

SUGGESTED READINGS

1. Rao, S.S, Mechanical Vibrations, 5th edition, Prentice Hall ,2011
2. William Tyrrell Thomson, Marie Dillon Dahleh, Theory of Vibration with Applications, 5thedition,Prentice Hall,1998
3. Ramamurti. V, Mechanical Vibration Practice with Basic Theory, 1st edition, Narosa publishing house, New Delhi,2000
4. S. Graham Kelly, Mechanical Vibrations: Theory and Applications, SI Edition, Cengage learning,2012.

18BEME6E11 DESIGN AND ANALYSISOF EXPERIMENTS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrialprocesses.
2. To understand the important concepts of single factorial designs
3. To Study and acquire knowledge on various methodologies involved in single factorial designs
4. To know the application of testing of factorial experiment
5. To enrich the understanding of special experimental designs
6. To impart knowledge on basic concepts of Taguchi method in parameter design

COURSE OUTCOMES

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

1. Understand the knowledge of various techniques for experimentalplanning
2. Understand the concepts of single factorialdesigns
3. List the various methodologies involved in single factorialdesigns
4. Apply the concept of testing of factorialexperiment
5. Solve the partial and ordinary differential equations special experimentaldesigns
6. Apply the basic concepts of Taguchi method in parameterdesign

UNITI INTRODUCTION

Planning of experiments – Steps – Need - Terminology: Factors, levels, variables, experimental error, replication, Randomization, Blocking, Confounding.

UNITII SINGLE FACTOREXPERIMENTS

ANOVA rationale - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel‘s test, Duncan‘s Multiple Range test, Latin Square Design, Graeco-Latin Square Design, Balanced incomplete design.

UNITIII FACTORIALEXPERIMENTS

Main and interaction effects –Two and three Factor full factorial Designs, 2 k deigns with Two and Three factors-Unreplicated design- Yate‘s Algorithm

UNITIV SPECIAL EXPERIMENTALDESIGNS

Blocking in factorial design, Confounding of 2k design, nested design-Response Surface Methods.

UNITV TAGUCHI TECHNIQUES

Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

SUGGESTED READINGS

1. Montgomery, D.C, Design and Analysis of Experiments, 1st edition, John Wiley and Sons,2013
2. Hicks. C.R, Fundamental concepts in the Design of Experiments, 4th edition, Oxford Universitypress,1993
3. Krishnaiah K, Applied Design Of Experiments And Taguchi Methods, 1st edition, PHI Learning Pvt Ltd, 2012
4. Ross. P.J, Taguchi Techniques for quality Engineering, 2nd edition, Prentice Hall,2005

18BEME6E12 HYBRIDVEHICLETECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cellvehicles.
2. To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performanceanalysis.
3. To impart knowledge on various energy source
4. To provide knowledge on concepts of electric propulsionsystems
5. To expose students to various drive trains for hybrid electricvehicles
6. To facilitate the understanding of the concepts of electronic converters

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Understand the concepts of electric and hybrid electricvehicles
2. Describe about the various energy source available for the hybrid electricvehicles.
3. Explain the concepts of electric propulsionsystems
4. Design series drive train for hybrid electricvehicles
5. Design parallel drive train for hybrid electricvehicles
6. Understand the concepts of electronic converters for battery charging of electric hybridvehicles.

UNITI ELECTRIC AND HYBRID ELECTRICVEHICLES

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains

UNITII ENERGY STORAGE FOR EV ANDHEV

Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors.

UNITIII ELECTRIC PROPULSION

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

UNITIV DESIGN OF ELECTRIC AND HYBRID ELECTRICVEHICLES

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design

UNITV POWER ELECTRONIC CONVERTER FOR BATTERYCHARGING

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, Highfrequency transformer based isolated charger topology, Transformer less topology.

SUGGESTED READINGS

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, 3rd edition, CRC Press2018
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press2011
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles , 1st edition, Springer,2013
4. Ron Hodkinson and John Fenton, Light Weight Electric/Hybrid Vehicle Design, 1st edition, Butterworth Heinemann, 2001
5. Chan.C.Cand.Chau.K.T, Modern Electric Vehicle Technology, 1st edition, OXFORD University Press 2001
6. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives , 2nd edition, Wiley Publication2017.

PROFESSIONAL ELECTIVE III

18BEME7E01 DESIGN FOR MANUFACTUREAND ASSEMBLY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the importance of the DFM approach and guidelines
2. To enrich the understanding of the selective assembly and Datum systems
3. To introduce the concepts of demonstrate true Position tolerancing theory.
4. To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.
5. To equip them with skills on Tolerance Charting Technique.
6. To Study and acquire knowledge of the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

1. Understand the DFM approach and guidelines
2. Understand the selective assembly and Datum systems
3. Demonstrate true Position tolerancing theory.
4. Understand redesigning cast members using weldments and plastic component manufacturing.
5. Demonstrate the Tolerance Charting Technique.
6. Know the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALSIN INDUSTRY

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka – Yoke principle; 6σ concept; Tolerance Analysis: Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normallaw.

UNIT II SELECTIVEASSEMBLY

Interchangeable and selective assembly, deciding the number of groups, Model–I: group tolerances of mating parts equal; Model–II: total and group tolerances of shaft, control of axial play.

Datum Systems: Grouped datum systems–different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, and tongue–slot pair, computation of translational and rotational accuracy.

UNIT III TRUE POSITION TOLERANCINGTHEORY

Comparison between co–ordinate and convention method of feature location tolerancing and true position tolerancing, zero true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, functional gauges, paper layout gauging, compound assembly,examples.

UNIT IV FORM DESIGN OF CASTINGS ANDWELDMENTS

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V TOLERANCECHARTING

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining. Datum features – functional and manufacturing, component design–machining considerations, redesign for manufacture,examples.

SUGGESTED READINGS

1. Harry Peck, Designing for Manufacture, 1st edition, Pitman Publications, London,1973
2. Gerhard Pahl, Wolfgang Beitz, Engineering Design – A Systematic Approach, 3rd Edition, Springer Science & Business Media,2007.
3. Spotts M F, Dimensioning and Tolerance for Quantity Production, 1st edition, Prentice Hall Inc., New Jersey, USA, 2008(Digital)
4. Oliver R Wade, Tolerance Control in Design and Manufacturing, 1st edition, Industrial press Inc., New York, 2008(Digital)
5. James G Bralla, Hand Book of Product Design for Manufacturing, 1st edition, McGraw Hill Publications, New Delhi, 2000(Digital)
6. Clyde M. Creveling, Tolerance Design – A Hand Book for Developing Optimal Specifications, 1st edition, Prentice Hall,2012

18BEME7E02 COMPUTATIONALFLUIDDYNAMICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce Governing Equations of viscous fluidflows
2. To introduce numerical modeling and its role in the field of fluid flow and heattransfer
3. To enable the students to understand the various discretization methods, solution procedures and turbulencemodeling.
4. To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speedcomputers.
5. To equip them with skills to solve convection and diffusionproblems
6. To understand the importance continuity and momentum equations for different types of fluidflow

COURSE OUTCOMES

Upon completion of this course, the students can able

1. Identify, solve engineering problems by computational fluiddynamics.
2. Understand the importance of governing equations involved inCFD
3. Formulate and solve problems in the field of fluid flow and heattransfer.
4. Solve the heat conduction problems using finite differencemethod.
5. Analyze and provide solutions for convection and diffusionproblems.
6. Develop continuity and momentum equations for different types of fluidflow.

UNITI GOVERNING EQUATIONS AND BOUNDARYCONDITIONS

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time–averaged equations for Turbulent flow – Turbulence –Kinetic –Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolicequations.

UNITII DISCRETIZATION AND SOLUTIONMETHODOLOGIES

Methods of Deriving the Discretization Equations – Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNITIII HEATCONDUCTION

Finite difference and finite volume formulation of steady/transient one–dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

UNITIV CONVECTION ANDDIFFUSION

Finite volume formulation of steady one–dimensional convection and Diffusion problems, Central, upwind, hybrid and power–law schemes – Discretization equations for two dimensional convection and diffusion.

UNITV CALCULATION OF FLOWFIELD

Representation of the pressure – Gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and velocity corrections – Pressure – Correction equation, SIMPLE algorithm and its variants. Turbulence models: mixing length model, two equation (k–ε) models.

SUGGESTED READINGS

1. Versteeg H.K and Malalasekera.W, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd edition, Pearson education,2008
2. Ghoshdastidar P.S, Computer Simulation of flow and heat transfer, 1st edition, Tata McGraw–Hill Publishing Company Ltd., New Delhi,1998.
3. Patankar S.V, Numerical Heat Transfer and Fluid Flow, 1st edition, CRC press,1980
4. Muralidhar K and Sundarajan T, Computational Fluid Flow and HeatTransfer,2nd edition, Narosapublication, 2014

18BEME7E03 **POWERPLANTENGINEERING** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To give exposure to accessories and layout required for a steam power plant depending upon the requirements.
2. To study performance of steam power plant.
3. To make the student acquire sound knowledge of working of nuclear and hydel power plant.
4. To study the features of gas turbine power plant.
5. To make the student acquire sound knowledge of economics of the power plant.
6. To make the student acquire sound knowledge on renewable energy technologies and availability.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Compute performance of steam power plant.
3. Explain the working of nuclear and hydel power plant.
4. Compute performance of gas turbine power plant.
5. Calculate the economics of the power plant.
6. Apply appropriate type of renewable energy technologies depending upon the application and availability.

UNITI INTRODUCTION TO POWER PLANTS ANDBOILERS

Introduction to Power Plants – Combined Power Cycles – Comparison and Selection, Load Duration Curves.Steam Boilers and Cycles – High Pressure and Super Critical Boilers – Fluidized Bed Boilers – Industrial Standards.

UNITII STEAM POWERPLANT

Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers

UNITIII NUCLEAR AND HYDEL POWERPLANTS

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety.

Hydel Power Plant – Essential Elements, Selection of Turbines, Governing of Turbines– Micro Hydel developments.

UNITIV DIESEL AND GAS TURBINE POWERPLANT

Types of Diesel Plants, Components, Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels – Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling – Combined Cycle.

UNITV OTHER POWER PLANTS AND ECONOMICS OF POWERPLANTS

Geo thermal –OTEC – Tidel – Pumped storage – Solar thermal central receiver system.Safety aspects and Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

SUGGESTED READINGS

1. Arora S.C and Domkundwar S, A course in Power Plant Engineering, 1st edition, Dhanpatrai Publishers, New Delhi,2014
2. Nag P.K, Power plant Engineering, 4th edition, Tata McGraw Hill, New Delhi,2014
3. Rajput R.K, Power Plant Engineering, 5th edition, Laxmi Publications, Chennai,2016
4. Morse Frederick T, Power Plant Engineering, 3rd edition, Prentice Hall of India, New Delhi, 2007(Digital)

18BEME7E04 ENERGY CONSERVATION METHODS ANDENERGY AUDIT **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand and analyze the energy data ofindustries
2. To carryout energy accounting andbalancing
3. To conduct energy audit and suggest methodologies for energysavings
4. To utilize the available resources in optimalways
5. To make the students conversant with concepts of industrialfurnaces
6. To equip them with skills to perform Energyaudit

COURSE OUTCOMES

At the end of the course, student will be able to

1. Understand the Environmental aspects of energyutilization
2. Perform combustionanalysis
3. Explain the concepts of industrialboiler
4. understand how to work with the steam generated from the boilers in the industrial point ofview
5. Explain the concepts of industrialfurnaces
6. Perform Energyaudit

UNITI ENERGYSCENARIO

Present status, rate of growth, energy utilization (sector wise), concept of energy conservation, energy economics. COMBUSTION: Fuel analysis, combustion calculations, air requirements, theoretical and excess air requirements, excess air control, flue gas analysis and measurement, types of draught, draught calculations, chimney size calculations. F.D and I.D fan draught requirements and power requirements, furnace pressure requirements.

UNITII INDUSTRIALBOILERS

Types and characteristics of industrial boilers, heat balance in boilers, efficiency trials in boilers, energy conservation opportunities in boilers operation and maintenance, water treatment requirements, soot blowing requirements, super heaters and superheat controls, waste heat recovery systems.
STEAM: Distribution requirements of steam and steamlines, efficient utilization of steam, steam trapping and air venting, flash steam recovery, condensate recovery, thermal insulation for systems including HVAC, steam balance calculations.

UNITIII INDUSTRIALFURNACES

Furnace types and characteristics, heat balance in furnaces, furnace efficiency calculations, energy conservation opportunities in furnaces, refractories types and properties, waste heat recovery system, insulating refractories, ceramic fibers, heat loss reduction calculations, wall and stored heat lossreduction.

UNITIV DRYING

Principle of drying and types of driers, mass and heat balance in driers, energy conservation opportunities in drying operations.
EVAPORATION: Principle of evaporation and types of evaporations, mass and heat balance, single and multiple effect evaporation, capacity and steam economy calculations, vapour recompression system.

UNITV ENERGY AUDIT AND APPLICATIONS

Types, methodology, questionnaire development, specific energy consumption (unitwise/section wise), identification of energy conservation measures/ technologies, economic and cost benefit analysis, case studies, Energy rating for thermal equipment,Energy saving measurement – Star status –National awards.

SUGGESTED READINGS

1. Turner, W. C., Doty, and Truner, W. C, Energy Management Hand book, 6th edition, Fairmont Press / CRC press, 2006
2. De. B. K., Energy Management audit & Conservation, 1st edition, Vrinda Publication,2010
3. W. Trinks, M. H. Mawhinney, Industrial Furnaces, 6th edition, John Wiley Publications, London,2006
4. Prabir Basu, Cen Kefa, Louis Jestin, Boilers and Burners Design and Theory, 1st edition, Springer Publications, New Delhi, 2000.

18BEME7E05 ADDITIVEMANUFACTURING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturingtechnologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
3. To introduce process involved in Additive manufacturingtechnology
4. To understand the importance of knowledge on software's used in additive manufacturingtechnology
5. To enrich the understanding of the working of SLS and othertechniques
6. To provide an overview of additive manufacturing technology in medicalfield and biostream

COURSE OUTCOMES

On completion of this course, students will be able to

1. Understand the need for additive manufacturingtechnology
2. Explain the process involved in Additive manufacturingtechnology
3. Get knowledge on software's used in additive manufacturingtechnology
4. Describe the working of SLS and othertechniques
5. Apply the additive manufacturing technology in medicalfield
6. Applications of additive manufacturing technology in biostream.

UNITI INTRODUCTION

Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications.

UNITII CAD & REVERSEENGINEERING

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Software's for Additive Manufacturing Technology: MIMICS,MAGICS.

UNITIII LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURINGSYSTEMS

Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNITIV POWDER BASED ADDITIVE MANUFACTURINGSYSTEMS

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron BeamMelting.

UNITV MEDICAL AND BIO-ADDITIVEMANUFACTURING

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

SUGGESTED READINGS

1. Chua C.K., Leong K.F., and Lim C.S, Rapid prototyping: Principles and applications, 3rd edition, World Scientific Publishers,2010
2. Gebhardt A, Rapid prototyping, 1st edition, Hanser Publications,2003
3. Frank W. Liou, Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, 2nd edition, CRC Press,2019.
4. Kamrani, Ali K., Nasr, Emad Abouel, Rapid Prototyping: Theory and practice, 1st edition, Springer,2015
5. Peter Hilton, Rapid Tooling: Technologies and Industrial Applications, 1st edition, CRC Press,2000.

18BEME7E06 LOGISTICS AND SUPPLYCHAINMANAGEMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturingtechnologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
3. To explain basics of SCM and logistics
4. To impart knowledge need for inventorymanagement
5. To expose students to value of information inSCM
6. To understand the concept ofinformation technology involved inSCM

COURSE OUTCOMES

On completion of this course, students will learn about

1. Basics of SCM and logistics
2. Understand the need for inventorymanagement
3. Apply the need for value of information inSCM
4. Describe about the various strategicalliances
5. Explain about the various issues in the internationalSCM
6. Get knowledge in information technology involved inSCM

UNIT IINTRODUCTION TO SUPPLY CHAIN MANAGEMENT

Definition, global optimization, Objectives of SCM. Logistics networks– data collection, model and data elevation, solution techniques.

UNITII INVENTORYMANAGEMENT

Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.

UNITIII VALUE OF INFORMATION

Bullwhip effect, information and supply chain technology. Supply chain integration– push, pull and push–pull system. Demand driven strategies, impact of internet on SCM, distribution strategies.

UNITIV STRATEGIC ALLIANCES

Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor–integration, procurement and out servicing strategies.

UNIT VINTERNATIONAL ISSUES IN SCM

Introduction, risks and advantages– design for logistics, supplies integration into to new product development, mass customization. Issues in customer value.

Information technology for SCM: Goals, standardization, infrastructure, DSS for supply chain management.

SUGGESTED READINGS

1. Simchi – Levi David, Kaminsky Philip and Simchi–Levi Edith, Designing and Managing the Supply Chain, 3rd edition, Tata M.Graw– Hill Publishing Company Ltd, New Delhi,2007
2. SunilChopraandPeterMeindl,SupplyChainManagement–Strategy, Planning and Operation, 2ndedition, Prentice Hall, New Delhi,2005
3. Ayers J.B, Hand book of Supply Chain Management, 1st edition, The St. Lencie press, New York,2000
4. Raghuram G and Rangaraj N, Logistics and Supply Chain Management: Cases and Concepts, 2nd edition, Macmillan, New Delhi,2009
5. Schary P.B, Lasen T.S, Managing the global supply chain, 3rd edition, Copenhagen Business School Press DK, New Delhi,2007
6. Thomas E Vollman, Clay Whybark D, Manufacturing Planning and Control for Supply Chain Management, 6th edition, Tata McGraw–Hill, New Delhi,2014.

PROFESSIONAL ELECTIVE IV

18BEME7E07 GAS DYNAMICS ANDJETPROPULSION 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the basic difference between incompressible and compressibleflow.
2. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and RocketPropulsion.
3. To introduce the concepts of various conditions of compressible fluidflows
4. To Study and acquire knowledge on performance analysis of subsonic and supersonicinlets, combustors, afterburners and exhaustnozzles
5. To understand the concept of working of various types of rocketengines
6. To study the features of thrust equation for rocket propulsionsystem

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Analyze various conditions of compressible fluidflows.
2. Calculate mass flow rate in flow through variable areaducts.
3. Carryout simple performance analysis of subsonic and supersonicinlets.
4. Perform performance analysis of combustors, afterburners and exhaustnozzles.
5. Understand the working of various types of rocketengines
6. Use thrust equation for rocket propulsionsystem.

UNITI BASIC CONCEPTS AND ISENTROPICFLOWS

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility – Isentropic flow through variable area ducts – Nozzle and Diffusers –area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles. Use of Gas tables.

UNITII FLOW THROUGHDUCTS

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Isothermal flow with friction in constant area ducts –Use of tables and charts – Generalised gas dynamics.

UNITIII NORMAL AND OBLIQUESHOCKS

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNITIV JETPROPULSION

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.

UNITV ROCKETPROPULSION

Types of rocket engines – Propellants – Ignition and combustion – Theory of rocket propulsion – solid and liquid propellants, comparison of different propulsion systems .Performance study – Staging – Terminal and characteristic velocity – Applications – Space flights.

(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS

1. Yahya.S.M, Fundamentals of Compressible flow, 6th edition,New Age International (P) Ltd., New Delhi, 2018
2. Rathakrishnan.E, Gas Dynamics, 6th edition,Prentice Hall of India, New Delhi,2017
3. Patrick.H.Oosthuizen, WillamE.Carscallen, Introduction to Compressible fluid flow, 2nd edition,CRC press, 2013
4. Zucker,R.D. and Biblarz,O, Fundamentals of Gas Dynamics, 2nd edition, John Wiley & Sons,2002
5. Ganesan .V, Gas Turbines, 3rd edition,Tata McGraw–Hill, New Delhi,2010
6. PhilipGrahamHill,CarlR.Peterson,MechanicsandThermodynamicsofPropulsion,2nd edition,Addison –Wesley Publishing Company, 2009(digital).

18BEME7E08 DESIGN OFMECHATRONICSYSTEMS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field ofautomation.
2. To understand the concepts of sensors andtransducers.
3. To provide an overview of actuationsystems.
4. To expose students tocontroller model for electrical, mechanical and thermalsystems.
5. To provide knowledge about various types ofcontrollers
6. To facilitate the understanding ofPLC program using ladderlogic.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Implement the concepts of sensors andtransducers.
2. Design the actuationsystems.
3. Develop the controller model for electrical, mechanical and thermalsystems.
4. Explain about various types ofcontrollers
5. Create the PLC program using ladderlogic.
6. DesignMechatronicssystem.

UNITI MECHATRONICS SENSORS ANDTRANSDUCERS

Introduction to Mechatronics – Systems – Measurement Systems – Control Systems –Traditional design – Microprocessor based Controllers. Introduction to sensors – Performance Terminology – Static and Dynamic characteristics – Displacement – Position and Proximity – Velocity and Motion – Fluid Pressure – Temperature Sensors – Light Sensors – Selection of Sensors – Signal processing – Servosystems.

UNITII ACTUATORS AND SYSTEMMODELS

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors.

Introduction to system models– Building block of Mechanical, Electrical, Fluid and Thermal Systems.

UNITIII MICROPROCESSORS INMECHATRONICS

Introduction – Architecture – pin configuration Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing. Input and output devices – interfacing D/A converters and A/D converters – Application – Temperature control – Stepper motor control.

UNITIV CONTROLLERS

Introduction –Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode –Derivative Mode – Integral Mode – PID Controllers –Digital Controllers – Adaptive Control – Digital LogicControl–MicroProcessorsControl.IntroductiontoPLC–BasicStructure–Input/OutputProcessing –Programming–Mnemonics–Timers,Internalrelaysandcounters–DataHandling–AnalogInput/Output – Selection of aPLC.

UNITV DESIGN OF MECHATRONICSYSTEMS

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 – Introduction to MEMS.

SUGGESTED READINGS

1. Bolton W, Mechatronics (Anna University): A Multidisciplinary Approach, 1st edition, Pearson Prentice Hall, Delhi,2008
2. Michael B. Histand David G. Alciatore, Introduction to Mechatronics and Measurement Systems, 4th edition, McGraw–Hill International Editions, New York,2014
3. NitaigourPremchandMahalik, Mechatronics : Principles, Concepts and Applications, 1st edition, McGraw–HillEducation, New Delhi,2003
4. Ghosh P.K and Sridhar P.R, Introduction to Microprocessors for Engineers and Scientist, 3rd edition, Prentice Hall of India, New Delhi,2009

18BEME7E09 MACHINETOOLDESIGN 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVE

1. To gain knowledge in design and material selection of various machinetools.
2. To provide an overview of regulation of speeds and feeds
3. To study the features of machine toolstructures
4. To understand the importance of constructional features of machine toolstructures
5. To expose students to design in machine tool structures, guide ways, power screws andspindles
6. To expose students to design spindles and spindlesupports

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. Discuss the basics machine tool drives andmechanisms
2. Get knowledge on regulation of speeds and feeds
3. Understand the importance of machine toolstructures
4. Explain the constructional features of machine toolstructures
5. Design in machine tool structures, guide ways, power screws andspindles
6. Design spindles and spindlesupports

UNITI INTRODUCTION TO MACHINE TOOL DRIVES ANDMECHANISMS

Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNITII REGULATION OF SPEEDS ANDFEEDS

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNITIII DESIGN OF MACHINE TOOLSTRUCTURES

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages

UNITIV DESIGN OF GUIDEWAYS, POWER SCREWS ANDSPINDLES

Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

UNITV DESIGN OF SPINDLES AND SPINDLESUPPORTS

Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools - Machine Tool Elastic System, Static and Dynamic Stiffness

SUGGESTED READINGS

1. Sen, G.C. and Bhattacharya, A, Principles of machine tools, 2nd edition, New Central Book Agency, Calcutta, 2009
2. Chernov N, Machine Tools, 2ndedition,Mir publishers Moscow,1989
3. N.K. Mehta, Machine Tool Design and Numerical Control, 3rd edition, Tata McGraw Hill, New Delhi, 2012
4. D. K Pal, S. K. Basu, Design of Machine Tools, 5th edition, Oxford IBH,2008
5. N. S. Acherkhan, Machine Tool Design, 1stedition,MIR publications,2011(digital)

18BEME7E10 COMPUTERINTEGRATEDMANUFACTURING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the application of computers in various aspects of Manufacturing viz., Design, proper planning, Manufacturing cost, Layout & Material Handlingsystem.
2. To know the application of principles of group technology in computer aided processplanning.
3. To impart knowledge on working of the shop floorcontrol
4. To Study and acquire knowledge on data collection system in FMS.
5. To familiarize the students to understand CIM architecture for practicalapplication.
6. To expose students to generate database for computer integrated manufacturingprocesses.

COURSE OUTCOMES

Upon completion of this course, the student can able to

1. Implement computer integrated manufacturing concepts inindustries.
2. Apply the principles of group technology in computer aided processplanning.
3. Understand the working of the shop floorcontrol
4. Implement automated data collection system in FMS.
5. Develop CIM architecture for practicalapplication.
6. Generate database for computer integrated manufacturingprocesses.

UNITI INTRODUCTION

The meaning and origin of CIM– the changing manufacturing and management scene – External communication – islands of automation and software–dedicated and open systems–manufacturing automation protocol – product related activities of a company– marketing engineering – production planning – plant operations – physical distribution– business and financial management.

UNITII GROUPTECHNOLOGY

Group technology– – part families – Classification and coding – Approaches to computer aided process planning –variant approach and generative approaches

UNITIII SHOP FLOOR CONTROL AND INTRODUCTION OFFMS

Shop floor control–phases –factory data collection system –automatic identification methods– Bar code technology– automated data collection system. FMS–components of FMS – types –FMS workstation –material handling and storage systems– FMS layout –computer control systems–application and benefits.

UNITIV CIM IMPLEMENTATION ANDDATACOMMUNICATION

CIM and company strategy – system modeling tools –IDEF models – activity cycle diagram – CIM open system architecture (CIMOSA)– manufacturing enterprise wheel–CIM architecture – Product data management–CIM implementation software. Communication fundamentals– local area networks –topology – LAN implementations – network management and installations –MRP, ERP concepts

UNITV OPEN SYSTEM AND DATABASE FORCIM

Open systems–open system inter connection – manufacturing automations protocol and technical office protocol (MAP /TOP).

Development of databases –database terminology– architecture of database systems–data modeling and data associations – relational data bases – database operators – advantages of data base and relational database.

SUGGESTED READINGS

1. Mikell.P.Groover, Automation, Production Systems and computer integrated manufacturing, 4e, Pearson Education, Delhi,2016
2. Yoram koren, Computer control of manufacturing systems, 1st edition, McGraw-Hill, New York,2005
3. Kant Vajpayee S, Principles of computer-integrated manufacturing, 3rd edition, Prentice Hall India, New Delhi,2003
4. Radhakrishnan P and SubramanyanS ,Raju.V, CAD/CAM/CIM, 4th edition, New Age International (P) Ltd, New Delhi,2018

18BEME7E11 ADVANCEDWELDINGTECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To enable the students to gain competence in various Welding Technologies and to have in depth understanding of the weldability of metals.
2. To expose students to Identify suitable reinforcement and matrix materials for preparation of composites using frictionstir processing.
3. To understand the basic principle of electron beam and laser beam processes andits application.
4. To understand the weldability of cast iron and high carbonsteel.
5. To provide knowledge on welding powersources.
6. To facilitate the understanding of grain growth mechanism and relatedproperties.

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Understand solid state welding processes andapplications.
2. Identify suitable reinforcement and matrix materials for preparation of compositesusing frictionstir processing.
3. Understand basic principle of electron beam and laser beam processes anditsapplication.
4. Understand weldability of cast iron and high carbonsteel.
5. Select welding powersources.
6. Understand the importance of grain growth mechanism and relatedproperties.

UNITI SOLID STATEWELDING

Solid state welding: classification of solid state welding processes, Adhesive bonding , advantages and applications.

UNITII FRICTION AND FRICTION STIRWELDING

Friction welding: Friction welding process variables, welding of similar and dissimilar materiasl, Defective analysis of friction welded components, Friction welding of materials with inter layer.
Friction stir welding: Processes parameters, tool geometry, welding of Aluminium alloys, Friction stir welding of Aluminum alloys and Magnesium alloys.

UNITIII ELECTRON BEAMWELDING

Electron Beam welding (EBW): Electron Beam welding process parameters, atmospheric affect Defective analysis of Electron beam welds and Electron Beam welding dissimilar materials.

UNITIV LASER BEAMWELDING

Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric affect and Laser Beam welding of steels.

UNITV SELECTION POWER SOURCE ANDWELDABILITY

Selection power source : Constant voltage and constant current power sources. Weldability of cast iron and steel : weldability studies of cast iron and steel

TOTAL

SUGGESTED READINGS

1. Howard B. Cary, Scott C. Helze., Modern Welding Technology, 6th edition, Pearson,2011.
2. Slobodan. Kralj, Welding Engineering and Technology, 1stedition,Eolss Publishers Company Limited, 2015.
3. D. L. Olson, T. A. Siewert, Metal Hand Book, Vol 06, Welding, Brazing and Soldering, ASM International Hand book Metals Park, Ohio USA,1993.

18BEME7E12 OPERATIONSRESEARCH 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

- To Formulate and solve engineering and managerial situations as LPP.
- To understand the Engineering and Managerial situations in Transportation.
- To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
- To give exposure to inventory in industry.
- To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
- To provide an overview of various tools in various sections of industries like marketing, material handling etc.

COURSE OUTCOMES

At the end of the course, student will be able to understand the

- Formulate and solve engineering and managerial situations as LPP.
- Solve Engineering and Managerial situations in Transportation.
- Give Engineering and Managerial solutions in Assignment and scheduling problems.
- Manage inventory in industry.
- Select better sequence to perform operation among various alternatives.
- Apply the various tools in various sections of industries like marketing, material handling etc.

UNITI INTRODUCTION TO OPERATIONSRESEARCH

Operations research and decision–making – types of mathematical models and constructing the model – Role of computers in operations research –Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method – The Big –M method – the two–phase method.

UNIT IITRANSPORTATION PROBLEMS

Least cost method, North west corner rule, Vogel's approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model.

UNIT IIIASSIGNMENT MODELS AND SCHEDULING

Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through 'm' machines, processing n jobs through m machines.

UNIT IVINVENTORY CONTROL AND QUEUING THEORY

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi item deterministic model.

Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT VPROJECT MANAGEMENT, GAME THEORY, REPLACEMENT MODELS

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing – Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

SUGGESTED READINGS

1. Kanti Swarup, Operations Research, 12th edition, Sultan Chand and Sons, New Delhi,2004
2. Viswanathan N and Narahari Y, Performance Modeling of Automated Manufacturing Systems,2nd edition, Prentice Hall of India,New Delhi,2005
3. Prem kumar Gupta and Hira D.S, Operation Research, 1st edition, S Chand and Company Limited, New Delhi,2012

PROFESSIONAL ELECTIVE V

18BEME7E13 MANUFACTURING AND INSPECTIONOFGEARS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To gain knowledge in production, gear materialselection
2. To introduce the concepts of gear manufacturing
3. To Study and acquire knowledge on mechanism involve in conicalgears
4. To Study and acquire knowledge on the procedures that involves in gear materialselection
5. To expose students to detailed view of gear finishingmethods
6. To impart knowledge modern gear productionmethods

COURSE OUTCOMES

Upon the completion of this course the students will be able to

1. Understand the overview on classification of gears and itterminology
2. Explain the various methods of gear manufacturing
3. Understands the concepts and mechanism involve in conicalgears
4. Understand the procedures that involves in gear materialselection
5. Attain a detailed view of gear finishingmethods
6. Understanding the modern gear productionmethods

UNITI INTRODUCTION TOGEARS

Types of gears-classification, application of gears, gearboxes, drawings for gears, gear production method an overview, types of blanks and blank preparation. Production Of Cylindrical Gears: Procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shapingmachines.

UNITII PRODUCTION OF CONICALGEARS

Production of straight bevel gears by bevel gear generator, duplex rotary cutter method, Gleason Reva cycle method, spiral and hybrid bevel gear generation. Description of machine, cutter and machine setting.

UNITIII GEAR MATERIAL SELECTION AND HARDENINGMETHODS

Properties of gear materials-non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high speed application. Selection of material for worm and wheel. Hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tuftriding, hardening defects.

UNITIV GEAR FINISHINGMETHODS

Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting. Gear Inspection: Type of gear errors-gear quality standards and allowable limits-tooth thickness, base tangent length measurement, pitch error, radial run out, involute profile error measurements methods and analysis, composite error measurement, computerized gear inspection, gear failure reasons andremedies.

UNITV MODERN GEAR PRODUCTIONMETHODS

Gear production by stamping, die casting, powder metal process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods, shear speed shaping, gear broaching, Gleayson G-TRAC – gear generation methods. Economical and Quality Production of Gears: Gear production systems – batch production, gear production cells, lean and agile production practices, automobile gear and gear boxes, heavy engineering gear production, gear for instruments and appliances, process and cutter selection for quantity, cost and qualitycriteria.

SUGGESTED READINGS

1. H J Watson, Modern Gear Production,1st edition, Elsevier,2013
2. Hindustan Machine Tools, Production Technology,1stedition,Tata McGraw Hill Co., New Delhi,2001
3. SAE Gear and Spline Technical Committee, Gear Design Manufacturing Inspection Manual, SAE,1990
4. Gitin M. Maitra, Handbook of Gear Design, 2ndedition,Tata McGraw-Hill Education,1994

18BEME7E14 COMPOSITEMATERIALS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the fundamentals of composite material strength and its mechanicalbehavior
2. Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of thefiber.
3. Thermo-mechanical behavior and study of residual stresses in Laminates duringprocessing.
4. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronicchips.
5. To introduce the concepts of carbon-carbon composite for different industrialapplication
6. To impart knowledge on various advances incomposites

COURSE OUTCOMES

Learners should be able to

1. Select the various types of composite matrix required for anapplication.
2. Choose appropriate manufacturing process for polymer matrix composite.
3. Opt appropriate manufacturing process for metal matrixcomposite.
4. Use the concepts of ceramic composites and its productiontechniques.
5. Identify the type of carbon-carbon composite for different industrialapplication.
6. Explain the various advances incomposites

UNITI INTRODUCTION TO COMPOSITES

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types ofcomposites.

UNITII POLYMER MATRIXCOMPOSITES

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand lay up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics(GRP).

UNITIII METAL MATRIXCOMPOSITES

Characteristics of MMC, Various types of Metal matrix composites Alloys - MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeezecasting.

UNITIV CERAMIC MATRIXCOMPOSITES

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing(HIPing).

UNITV ADVANCES INCOMPOSITES

Carbon /carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

SUGGESTED READINGS

1. Mathews F.L and Rawlings R.D, Composite Materials: Engineering and Science, 1st edition,Wood head publishing Ltd, England,1999
2. Chawla K.K, Composite materials: Science and Engineering, 3rd edition,Springer Science & Business Media, 2013
3. Clyne T.W and Withers P.J, An Introduction to Metal Matrix Composites,1st edition,Cambridge University Press, New York,1995
4. Strong A.B, Fundamentals of Composite Manufacturing, 2nd edition,Society of Manufacturing Engineering, 2008

5. Sharma S.C, Composite materials, 1st edition, Narosa Publications, New Delhi,2000

18BEME7E15 DESIGN OFHVACSYSTEMS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To enable the students to have better understanding about the concepts of Heat, Ventilation and Air conditioning and also equip them with the ability to solve problems relating to HVAC systems.
2. To impart knowledge on heating and cooling load calculations for different ambientconditions.
3. To Understand the importance Psychrometryprocesses
4. To facilitate the understanding of functions of refrigeratingcomponents.
5. To know the application of refrigerant with less GWP andODP
6. To expose students to different types of fan and itscharacteristics

COURSE OUTCOMES

At the end of the course, student will able to

1. Understand the basic concepts of Heat, Ventilation, and Airconditioning.
2. Solve heating and cooling load calculations for different ambientconditions.
3. Understand the importance Psychrometryprocesses
4. Equip themselves familiar with functions of refrigeratingcomponents.
5. Select refrigerant with less GWP andODP
6. Know the different types of fan and itscharacteristics

UNITI AIR CONDITIONINGFUNDAMENTALS

Basic Air Conditioning System , Location Of Air Conditioning Components In A Car- Schematic Layout of A Refrigeration System - Terminologies In HVAC: TR, COP, EER, SEER – Heat Exchanger And Its Types - Air Conditioning Components – Compressor, Condenser, Evaporator Expansion Valve

UNITII PSYCHROMETRY

Properties of Moist Air, Psychrometric Properties - Use of Psychrometric Chart - Psychrometric Processes In Air Conditioning Equipment - Summer Air Conditioning - Winter Air Conditioning

UNITIII LOADCALCULATION

Solar Radiation – Internal Heat Gains, Humidity And Air Flow- Heating Load Estimate And Cooling Load - Psychrometric Calculations For Cooling - Selection Of Air Conditioning Apparatus For Cooling And Dehumidification, Evaporative Cooling.

UNITIV REFRIGERANTS

Classification Of Refrigerants, Selection Of Refrigerants - Desirable Properties Of Refrigerant, Containers Handling Refrigerants-Tapping Into The Refrigerant Container - Ambient Conditions Affecting System Pressures

UNITV FANS AND AIRDISTRIBUTION

Fan Characteristics, Types Of Fans – Centrifugal Fans , Axial Fans- Fan Arrangements – Indoor Air Distribution – Total, Static And Velocity Pressures - Friction Loss In Duct, Dynamic Loss In Ducts, Air Flow Through Simple DuctSystem.

SUGGESTEDREADINGS:

1. C. P. Arora, Refrigeration and Air conditioning, 2nd edition, McGraw Hill Education (India) Private Limited,NewDelhi,2006.
2. William H. Crouse and Donald I. Anglin, Automotive Air conditioning, 2nd edition, McGraw Hill, 2009(digital).
3. Steven Daly,Automotive Air Conditioning and Climate Control Systems, 1st edition, Elsevier,2011.
4. Clifford L. Samuels, Automotive air conditioning, 1st edition, Prentice-Hall,1981

18BEME7E16 **NONDESTRUCTIVETESTING** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To provide an overview of destructive and non destructive tests and state theirapplications
3. To study the features of NDT techniques for variousproducts.
4. To expose students to skills needed for selection of appropriate NDT technique(s) for new inspectionjobs
5. To understand the established NDE techniques and basic familiarity of emerging NDE techniques.
6. To facilitate the understanding of standard application area ofNDET

COURSE OUTCOMES

Student will be able to

1. Understand the codes, standards and specifications related toNDT
2. Classify the destructive and non destructive tests and state theirapplications
3. Develop NDT techniques for variousproducts.
4. Acquire skills needed for selection of appropriate NDT technique(s) fornew inspectionjobs
5. Acquire sound knowledge of established NDE techniques and basicfamiliarity of emerging NDE techniques.
6. Make use of standards application area ofNDET

UNITI INTRODUCTION

Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys. Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications(ASME, ASTM, AWS etc.).

UNITII PENETRANT TESTING AND MAGNETIC PARTICLEINSPECTION

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrants Testing,Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle CrackDetection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION

Introduction to Ultrasonic Flaw Detection ,An Illustration of Ultrasonic Flaw Detection , Advantages of Ultrasonic Flaw Detection, Disadvantages of Ultrasonic Flaw Detection, Principle of Radiography Inspection, Radiation sources, Attenuation in the specimen, Radiographic imaging, Inspection Techniques, Application and limitations, Safety.

UNITIV EDDY CURRENT AND ELECTRO-MAGNETICMETHODS

Introduction to Eddy Current Testing.An Illustration of Eddy Current Testing Equipment , Advantages of Eddy Current Testing, Disadvantages of Eddy Current Testing

UNITV NON-DESTRUCTIVE INSPECTION(NDI) AND ITSAPPLICATIONS

Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

SUGGESTED READINGS

1. Louis Cartz, Nondestructive Testing, 1st edition,ASMInternational,Almere,Netherland,2007(digital)
2. Paul E. Mix, Introduction to Nondestructive Testing, 2nd edition,John Wiley &Sons,Newyork.,2005
3. Baldev Raj, T. and Jayakumar, M. , Practical Non-destructive Testing, 2nd edition,Woodhead Publishing,Cambridge.,2007
4. J. Blitz, G. Simpson, Ultrasonic Methods of Non-destructive Testing,1st edition,Springer Science & Business Media,1996

18BEME7E17 INDUSTRIALSAFETYENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To acquaint the student with the need and awareness of the safetyconcepts
3. To understand the importance of various safety techniques involved in industrialsector
4. To introduce the concepts of accident zone and prepare reports related toit.
5. To equip them with skills to conduct basic safety inspections using strategies that theyhave developed
6. To develop an understanding ofsafetymonitoring

COURSE OUTCOMES

At the end of the course, student will be able to

1. Understand the need and awareness of the safetyconcepts
2. Understand the various safety techniques involved in industrialsector
3. Record and investigate the accident zone and prepare reports related toit.
4. Conduct basic safety inspections using strategies that theyhave developed
5. Identify and demonstrate working of safetymonitoring
6. Train about the education and training based onsafety

UNITI CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNITII TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNITIII ACCIDENT INVESTIGATION ANDREPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNITIV SAFETY PERFORMANCEMONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

UNITV SAFETY EDUCATION ANDTRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations,3rd edition, N.S.C.Chicago,2010(digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill Company,New York,1941.
3. Krishnan N.V,Safety Management in Industry,1st edition,Jaico Publishing House, Bombay,1997.
4. John R Ridley,Safety at Work,3rd edition,Elsevier,2014
5. Roland P. Blake ,Industrial Safety, 2nd edition,Prentice Hall, Inc., New Jersey,1973
6. L M Deshmukh,Industrial safety management,1st edition, TATA McGraw Hill,2005

18BEME7E18 SURFACEENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study the surface preparationtechniques
2. To import knowledge on thermal spraying process and electrodepositedcoating
3. To study the process of Hot dip and diffusioncoating
4. To induce the testing procedure for surfacecoating
5. To introduce the methods of non metalliccoating
6. To impart knowledge on testing procedure for qualityassurance

COURSE OUTCOMES

Upon completion of this course, students will be able to

1. Explain the important of surface engineering toindustries
2. Use of thermal spray forcoating
3. Explain the working principle of hot dipcoating
4. Explain the process and mechanism of different diffusion coatingprocess
5. Explain the methods of non metalliccoating
6. Explain the testing procedure for qualityassurance.

UNITI METAL CLEANING AND PREVIEW ON SURFACEENGINEERING

Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non-ferrous metals and alloys – selection of cleaning process – alkaline cleaning – emulsion cleaning-ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning– polishing and short peening – classification of surface engineering processes.

UNITII THERMAL SPRAYING PROCESSES AND ELECTRODEPOSITEDCOATINGS

Thermal spraying – flame, arc, plasma and HVOF processes – PLV process – design for thermally sprayed coatings – coating production – spray consumables principles of electroplating – Technology and control electroplating systems – properties and Faraday's Law – factors affecting throwing power – Applications of electrodeposites – non-aqueous and electroless deposition.

UNITIII HOT DIP COATING AND DIFFUSIONCOATINGS

Principles – surface preparation batch coating and continuous coating process – coating properties and applications, Principles of cementation – cladding – Diffusion coating of C.N. Al, Si, Cr and B – structure, properties and application of diffusion coatings – chemical vapour deposition – physical vapour deposition.

UNITIV NON-METALLIC COATING OXIDE AND COVENSIONCOATINGS

Plating coating – laequers – rubbers and elastomers – vitreous enamels – anodizing phosphating and chromating – application to aluminium, magnesium, tin, zinc, cadmium copper and silver – phosphating primers.

UNITV QUALITY ASSURANCE, TESTING AND SELECTION OFCOATINGS

The quality plan – design – testing and inspection of thickness adhesion, corrosion, resistance and porosity measurement – selection of coatings – industrial applications of engineering coatings. Basic mechanisms of wear – abrasive, adhesive wear, contact fatigue – fretting corrosion – testing wear resistance practical diagnosis of wear.

SUGGESTED READINGS

1. Stand Grainger,Engineering coatings – design and application, 2nd Edition, Abington publishing,1998.
2. Parthasarathy. N.V., Electroplating Handbooks, 1st edition, Prentice Hall, 2007(Digital)
3. Metals Hand Book vol.2, 8thEdition, American society of metals1994
4. Gabe. D.R., Principles of Metal surface treatment and protection, 2nd edition, Pergamon press,2014.
5. A Niku-Lari, Advances in surface treatments, vol. 5, Pergamon press,2013.

PROFESSIONAL ELECTIVE VI

18BEME8E01 QUALITY CONTROL ANDRELIABILITY ENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

- To Understand the concept of SQC.
- To enrich the understanding of control charts to analyze for improving the process quality.
- To familiarize the students to understand different sampling plans
- To Understand the importance of need and types of life testing.
- To introduce the reliability of a system.
- To introduce the concepts of quality control and reliability techniques in industries.

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- Understand the concept of SQC.
- Use control charts to analyze for improving the process quality.
- Describe different sampling plans
- Understand the need and types of life testing.
- Improve the reliability of a system.
- Implement quality control and reliability techniques in industries.

UNITI INTRODUCTION AND PROCESS CONTROL FORVARIABLES

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost–Variation in process– factors – process capability – process capability studies and simple problems – Theory of control chart– uses of control chart – Control chart for variables – X chart, R chart and σ chart.

UNITII PROCESS CONTROL FORATTRIBUTES

Control chart for attributes –control chart for proportion or fraction defectives – P chart and NP chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

UNITIII ACCEPTANCESAMPLING

Lot by lot sampling – Types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts–standard sampling plans for AQL and LTPD– uses of standard samplingplans.

UNITIV LIFE TESTING –RELIABILITY

Life testing – objective: – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNITV QUALITY AND RELIABLITY

Reliability improvements – techniques– use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles – Maintenance.

Note: Permitted to use approved statistical table in the examination.

SUGGESTED READINGS

1. Eugene Grant and Richard Leavenworth, Statistical Quality Control, 7th edition, Tata McGraw–Hill, New Delhi,2000
2. Srinath L.S, Reliability Engineering, 3rdedition,Affiliated East west press New Delhi,1991.
3. Manohar Mahajan, Statistical Quality Control, 1stedition,Dhanpat Rai and Sons, New Delhi,2006.
4. Gerald M. Smith, Statistical Process Control and Quality Improvement, 5thEdition, Pearson Int,2004.
5. Danny Samson, Manufacturing and Operations Strategy, 1stedition,Prentice Hall, New Delhi, 2007 (Digital).
6. Patrick D. T. O'Connor, Practical Reliability Engineering, 4th edition, John Wiley, New Delhi,2008.

18BEME8E02 PRODUCTION PLANNINGANDCONTROL 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

- To impart knowledge of need for planning and control in various aspects.
- To develop an understanding of the standard techniques in various work study methodologies.
- To familiarize the students to understand the product and process plan.
- To introduce the concepts of a production schedule based on different facets.
- To enrich the understanding of the level of inventory
- To understand the importance the recent advancements in production planning and control.

COURSE OUTCOMES

Student will be able to

- Indicate the need for planning and control in various aspects.
- Understand various work study methodologies.
- Construct product and process plan.
- Prepare a production schedule based on different facets.
- Estimate the level of inventory
- Understand the recent advancements in production planning and control.

UNITI INTRODUCTION

Objectives: and benefits of planning and control–Functions of production control–Types of production–job– batch and continuous–Product development and design–Marketing aspect – Functional aspects–Operational aspect– Durability and dependability aspect–aesthetic aspect. Profit consideration–Standardization, Simplification and specialization–Break even analysis–Economics of a new design.

UNITII WORKSTUDY

Method study, basic procedure–Selection–Recording of process – Critical analysis, Development – Implementation – Micro motion and memo motion study – work measurement – Techniques of work measurement – Time study – Production study – Work sampling – Synthesis from standard data – Predetermined motion time standards.

UNITIII PRODUCT PLANNING AND PROCESSPLANNING

Product planning–Extending the original product information–Value analysis–Problems in lack of product planning–Process planning and routing–Pre requisite information needed for process planning–Steps in process planning–Quantity determination in batch production–Machine capacity, balancing–Analysis of process capabilities in a multi product system.

UNITIV PRODUCTIONSCHEDULING

Production Control Systems–Loading and scheduling–Master Scheduling–Scheduling rules–Gantt charts– Perpetual loading–Basic scheduling problems – Line of balance – Flow production scheduling–Batch production scheduling– Product sequencing – Production Control systems–Periodic batch control–Material requirement planning Kanban – Dispatching–Progress reporting and expediting–Manufacturing lead time– Techniques for aligning completion times and due dates.

UNITV INVENTORY CONTROL AND RECENT TRENDS INPPC

Inventory control–Purpose of holding stock–Effect of demand on inventories–Ordering procedures.
Two bin system –Ordering cycle system–Determination of Economic order quantity and economic lot size– ABC analysis–Recorder procedure–Introduction to computer integrated production planning systems–elements of JIT Systems–Fundamentals of MRP and ERP, KANBAN system.

SUGGESTED READINGS

1. MartandTelsang, Industrial Engineering and Production Management, 3rd edition, S.Chand and Company, New Delhi,2018
2. Samson Eilon, Elements of production planning and control, 1st edition, Macmillan, India,1991
3. Elwood S.Buffa, and Rakesh K.Sarin, Modern Production Operations Management, 8th edition, John Wiley and Sons, New Delhi,2009
4. Jain C.K and Aggarwal L.N, Production Planning Control and Industrial Management, 8thedition,Khanna Publishers, New Delhi,1999

18BEME8E03 COGENERATION AND WASTE HEATRECOVERY SYSTEMS **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study the significance of waste heat recovery systems and carry out its economicanalysis
2. To know the concepts of cogeneration, its types and probable areas ofapplications
3. To enrich the understanding of thermodynamics, heat transfer, and fluid Mechanics principles to design and analysis of thisemerging technology.
4. To impart knowledge on operational issues and challenges cogenerationtechnologies.
5. To Understand the impact of this technology in waste heat recoverysystems
6. To introduce the concepts of various systems involved in waste heat recoveryprocess

COURSE OUTCOMES

The student will be able to

1. Understand the various methods ofcogeneration.
2. Apply knowledge of thermodynamics, heat transfer, and fluid Mechanics principles to design and analysis of thisemerging technology.
3. Have thorough understanding, operational issues and challenges cogenerationtechnologies.
4. Understand the impact of this technology in waste heat recoverysystems
5. Get the knowledge over various systems involved in waste heat recoveryprocess
6. Begin a career as an engineer in an organization economicanalysis

UNITI INTRODUCTION

Introduction – principles of thermodynamics – cycles – topping - bottoming – combined cycle - organic rankine cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of trigeneration.

UNITII COGENERATIONTECHNOLOGIES

Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling enginesetc.,

UNITIII ISSUES AND APPLICATIONS OF COGENERATIONTECHNOLOGIES

Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment

UNITIV WASTE HEAT RECOVERYSYSTEMS

Election criteria for waste heat recovery technologies - recuperators - Regenerators - Economizers - plate heat exchangers - thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps – sorption systems.

UNITV ECONOMIC ANALYSIS

Investment cost – economic concepts – measures of economic performance – procedure for economic analysis – examples – procedure for optimized system selection and design – load curves - sensitivity analysis– regulatory and financial frame work for cogeneration and waste heat recovery systems.

SUGGESTED READINGS

1. R.Kehlhofer, B. Rukes, F. Stirnimann, Combined-cycle gas & steam turbine power plants, 3rd edition, PennWell Books,2009
2. A.Thumann, D. Paul Mehta, Handbook of energy engineering, 6th edition, The Fairmont Press Inc,2008
3. B.F.Kolanowski, Small-scale cogeneration handbook, 3rd edition, Fairmont Press,2008
4. M.P. Boyce, Handbook for cogeneration and combined cycle power plants, 2nd edition, ASME Press,2010

18BEME8E04 INDUSTRIALENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To Understand and apply the principles of science, technology, engineering, and math to solve industry– relatedproblems.
2. To Understand the concepts and terminologies inIndustries
3. To Study and acquire knowledge in creating an industrial designlayout
4. To introduce the methods involved in materialshandling
5. To understand the knowledge in analysis of work processing happening inindustries
6. To equip them with skills to perform work measurement in anindustry

COURSE OUTCOMES

Upon completion of this course, the student can able to

1. Understand the concepts and terminologies inIndustries
2. apply their knowledge in creating an industrial designlayout
3. understand the methods involved in materialshandling
4. apply their knowledge in analysis of work processing happening inindustries
5. perform work measurement in anindustry
6. understand the role of human involvement in industrial work systemdesign

UNITI INTRODUCTION TO INDUSTRIALENGINEERING

for layout study – types of layout. Plant location analysis – factors, costs, location decisions – simple problems in single facility location models, network location problems.

UNITII LAYOUTDESIGN

Design cycle – SLP procedure manpower, machinery requirements – computer algorithms – ALDEP, CORELAP, CRAFT

UNITIII QUANTITATIVE METHODS AND MATERIALSHANDLING

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing. Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging, Material Handling—Automatic Storage and Retrieval System (ASRS)

UNITIV OPERATIONS ANALYSIS AND WORKMEASUREMENT

Productivity and living standards, Productivity measurement, work design and Productivity – process planning – types. Total time for a job or operation, total work content and ineffective time, methods and motions, graphic tools. Stop watch time study – time study through videography, Standard data, methods time measurement (MTM), Development of Production Standards, learningeffect.

UNITV HUMAN FACTORS IN WORK SYSTEMDESIGN

Human factors Engineering/Ergonomics, human performance in physical work, anthropometry, design of work station, design of displays and controls.

SUGGESTED READINGSs

1. O.P. Khanna, Industrial Engineering and Management, 4th edition, Dhanpat rai and Co,1980.
2. MartandTelsang, Industrial Engineering and Production Management, 3rd edition, S.Chand and Company, New Delhi,2018
3. Tompkins.J.A. and J.A. White, Facilities planning, 4thedition, John Wiley,2012
4. James MacGregor Apple, Plant Layout and Material Handling, 3rd edition, Ronald Press, 1977, 2007 (Digital)
5. Ralph M. Barnes, Motion and Time Study Design and Measurement of Work, 7thedition,John Wiley, 2007.
6. Bridger R. S, Introduction to Ergonomics, 3rdedition,Taylor& Francis Group,2009

18BEME8E05 COMPUTER AIDED DRAFTING ANDCOSTESTIMATION 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To gain knowledge in sequence of process planning and cost estimation of variousproducts.
2. To introduce the concepts of dimensional and toleranceanalysis
3. To expose students to manufacturingdrawings
4. To equip them with skills to apply their knowledge in re-dimensioning and tolerancecharting
5. To understand the process chart for a givencomponent
6. To Estimate the cost of a givencomponent

COURSE OUTCOMES

Upon completion of this course, the student can able to

1. Apply the various standards and conventions used in a drawingsheet
2. Perform dimensional and toleranceanalysis
3. Understand the manufacturingdrawings
4. Apply their knowledge in re-dimensioning and tolerancecharting
5. Prepare process chart for a givencomponent
6. Estimate the cost of a givencomponent

UNITI STANDARDS ANDCONVENTIONS

Current international standards (ISO) and Indian Standards (IS)- types of lines - principles of presentation - dimensioning - conventional representation of threaded parts, springs, and gears.

UNITII DIMENSIONAL AND FORMTOLERANCES

Limits and fits IT system of tolerances, deviation of fit - geometric tolerance-tolerancing of form, orientation, location and runout - datums and Datum systems-Dimensioning and tolerancing of profiles

UNITIII MANUFACTURINGDRAWINGS

Surface texture indication on drawing - welds symbolic representation of drawings. Given a sub-assembly/assembly to prepare manufacturing drawings of components, Sample exercises on CAD- preparation of manufacturing Drawings.

UNITIV RE-DIMENSIONING AND TOLERANCECHARTING

Introduction to re-dimensioning to suit manufacturing requirements-manufacturing datum-functional datum. Introduction to tolerance charting

UNITV COSTESTIMATION

Preparation of Process chart for a given component-estimation of setting time and machining time-estimation of material cost, labour cost and overhead cost based on supplieddata.

SUGGESTED READINGS

1. Siddeshwar and Kanniah, Machine Drawing, 1st edition, Tata McGraw Hill,2001
2. Ajeet Singh, Machine Drawing, 2nd edition, Tata McGraw Hill,2012.
3. Gopalakrishna, K.R, Machine Drawing, Subhas Stores,2002
4. Wade. O, Tolerance Control in design and manufacturing, Industrial Press,1972
5. R. Kesavan, C. Elanchezhian, B. Vijaya Ramanath, Process Planning and Cost Estimation, 1st edition, New Age International,2009

18BEME8E06 TOTALQUALITYMANAGEMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce the concepts of essentiality of quality.
2. To understand the importance of various TQM principles.
3. To introduce the concepts of the various TQM principles.
4. To Understand the techniques for quality management.
5. To introduce the standard quality systems in industries.
6. To familiarize the students to understand the various techniques to improve the quality in industries.

COURSE OUTCOMES

At the end of the course the student would be able to

1. Understand the essentiality of quality.
2. Summarize various TQM principles.
3. Understand the various TQM principles.
4. Understand the techniques for quality management.
5. Implement standard quality systems in industries.
6. Apply various techniques to improve the quality in industries.

UNIT I ESSENTIALS OFTQM

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNITII TQMPRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III TQMTOOLS

The new seven management tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma – APQP.

UNITIV TQMTECHNIQUES

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNITV QUALITY AND ENVIRONMENTSYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9000:2002 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 and ISO 18001 – Concept, Requirements and Benefits.

SUGGESTED READINGS

1. Dale H. Besterfiled, Total Quality Management, 4th edition, Pearson Education, Delhi,2015
2. Joseph A. Defeo, Juran's Quality Management and Analysis, 6thEdition, McGraw Hill International,2015
3. Ramasamy Subburaj, Total Quality Management, 1stEdition, McGraw Hill ,2011
4. Oakland.J.S, Total Quality Management, 1st edition, Butterworth Heinemann,1996.
5. Narayana V. and Sreenivasan N.S, Managing Quality – Concepts and Tasks, 1st edition, New Age International Ltd., New Delhi, 2010.
6. M Zairi, Total Quality Management for Engineers, 1st edition, Wood Head Publishers, New Delhi, 2010 (Digital)

OPEN ELECTIVES

COURSES OFFERED BY OTHER DEPARTMENTS

18BESHOE01 PROBABILITY ANDRANDOMPROCESS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2. To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
3. To understand the basic concepts of random processes which are widely used in IT fields.
4. To understand the concept of correlation and spectral densities.
5. To understand the significance of linear systems with random inputs.
6. analyze the response of random inputs to linear time invariantsystems

COURSE OUTCOMES

Upon successful completion of the course, students should be able:

1. To understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. To understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
3. To apply the concept random processes in engineering disciplines.
4. To understand and apply the concept of correlation and spectral densities.
5. The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
6. To analyze the response of random inputs to linear time invariant systems.

UNITI MEASURES OF CENTRAL TENDENCY ANDPROBABILITY

Measures of central tendency – Mean, Median, Mode - Standard Deviation Probability - Random variable - Axioms of probability - Conditional probability - Total probability – Baye's theorem.

UNITII STANDARDDISTRIBUTIONS

Functions of a random variable - Binomial, Poisson, Uniform, Exponential, Gamma(one Parameter only) and Normal distributions - Moment generating functions, Characteristic function and their properties – Chebyshev'sinequality.

UNITIII TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions - Probability mass function - Probability density functions – Covariance - Correlation and regression

UNITIV CLASSIFICATION OF RANDOMPROCESS

Definition and examples - first order, second order, strictly stationary, wide – sense stationary and Ergodic processes - Markov process - Binomial, Poisson and Normal processes - Sine wave process.

UNITV CORRELATION AND SPECTRALDENSITIES

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density – Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function Linear time invariant system - System transfer function –Linear systems with random inputs – Auto correlation and cross correlation functions of input andoutput.

SUGGESTED READINGS

1. Peebles Jr, P.Z, Probability Random Variables and Random Signal Principles, Tata McGraw-Hill Publishers, New Delhi.,2002
2. Ross, S, A first Course in Probability, Pearson Education,New Delhi (Chap 2 to 8),2012
3. Gupta, S.C. and Kapoor, V.K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi. ,2014
4. Veerarajan,T., Probability, Statistics and Random process, Tata McGraw-Hill Education pvt. Ltd., New Delhi,2008
5. Henry Stark and John W. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education, Third edition, Delhi,2002.

18BESHOE02 FUZZYMATHEMATICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Be able to understand basic knowledge of fuzzy sets and fuzzy logic
2. Be able to apply basic knowledge of fuzzy operations.
3. To know the basic definitions of fuzzy relations
4. Be able to apply basic fuzzy inference and approximate reasoning
5. To know the applications of fuzzy Technology.
6. Enable students to Solve problems that are appropriately solved by neural networks, fuzzy logic.

COURSE OUTCOMES

1. To gain the main subject of fuzzy sets.
2. To understand the concept of fuzziness involved in various systems and fuzzy set theory.
3. To gain the methods of fuzzy logic.
4. To comprehend the concepts of fuzzy relations.
5. To analyze the application of fuzzy logic control to real time systems.
6. The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

UNITI FUZZYSETS

Fuzzy Sets: Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh's Extension Principle

UNITII OPERATIONS ON FUZZYSETS

Operations on Fuzzy Sets Operations on [0,1] – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNITIII FUZZYRELATIONS

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNITIV FUZZYMEASURES

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

UNITV FUZZYINFERENCE

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

SUGGESTED READINGS

1. George J KlirandBo Yuan, Fuzzy Sets and Fuzzy Logic : Theory and Applications, Prentice Hall NJ , 2003
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, New Delhi,2001
3. Michal Baczynski and Balasubramaniam , Fuzzy Implications, Springer Verlag, Heidelberg,2008
4. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman,1998

18BESHOE03 **LINEARALGEBRA** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce the basic concepts of vector space
2. To know the fundamentals of linear Algebra
3. To solve system of linear equations
4. To study about the linear transformations
5. To introduce the concepts of inner product spaces
6. To apply linear algebra in other branches of sciences, engineering, and economics.

COURSE OUTCOMES

The student will be able to

1. To explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
2. To describe the fundamental concepts of Eigen values and Eigen vectors by using Power method.
3. To apply the fundamental concepts in their respective engineering fields
4. To visualize linear transformations as matrix form
5. To recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
6. To articulate the importance of Linear Algebra and its applications in branches of Mathematics

UNITI VECTORSPACES

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space

UNITII EIGEN VALUES AND EIGENVECTORS

Eigen values and Eigen vectors - diagonalization - Power method - QR decomposition

UNITIII SYSTEM OF LINEAREQUATIONS

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss–Seidel method, convergence criteria.

UNITIV LINEARTRANSFORMATIONS

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors - Diagonalization

UNITV INNER PRODUCTSPACES

The Dot Product on R^n and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

SUGGESTED READINGS

1. Kreyszig,E, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.,2014
2. Shahnaz Bathul, Text book of Engineering Mathematics , PHI Publications, New Delhi.,2009
3. Kreyszig,E, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.,2014
4. Anton and Rorres, Elementary Linear Algebra, Applications version, Wiley India Edition,2012
5. Jim Defranza, Daniel Gagliardi, Introduction to Linear Algebra with Application, Tata McGraw-Hill , 2008

18BESHOE04 **ENGINEERINGACOUSTICS** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To disseminate the fundamentals of acoustic waves.
2. To inculcate the characteristics of radiation and reception of acoustic waves.
3. To divulge knowledge on the basics of pipe resonators and filters.
4. To introduce the features of architectural acoustics.
5. To impart the basic knowledge of transducers and receivers.
6. Recommend a safe healthy environment for the community and occupational welfare.

COURSE OUTCOMES

1. Develop the idea of the fundamentals of acoustic waves.
2. Apply the concepts of radiation and reception of acoustic waves.
3. Explain the basic ideas of pipe resonators and filters.
4. Illusrate the basics of architectural acoustics..
5. Illustrate the transducers and receivers and its applications in various electronic devices.
6. Apply the knowledge inputs of the course for engineering applications.

UNITI INTRODUCTION

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves -Energy density – Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales. Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence –method of images.

UNITII RADIATION AND RECEPTION OF ACOUSTICWAVES

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source radiation impedance - Fundamental properties of transducers. Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

UNITIII PIPES RESONATORS ANDFILTERS

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – detection threshold – the ear – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

UNITIV ARCHITECTURALACOUSTICS

Sound in endosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Weighted sound levels speech interference – highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

UNITV TRANSDUCTION

Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker – loudspeaker cabinets – horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers.

SUGGESTED READINGS

1. LawerenceE.Kinsler,AustinR.Frey,**,** Fundamentals of Acoustics**,** 4ht edition, John Wiley & Sons,2000
2. F. AltonEverest& Ken Pohlmann , Master Handbook of Acoustics, McGraw Hill Professional,2014

18BESHOE05 SOLIDWASTEMANAGEMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the students conversant with basics of Solid waste sand its classification.
2. To make the student acquire sound knowledge of different treatments of solid wastes.
3. To acquaint the student with concepts of waste disposals.
4. To develop an understanding of the basic concepts of Hazardous waste managements.
5. To acquaint the students with the basics of energy generation from waste materials..
6. To make the student understand about the disposal and treatment of waste scientifically.

COURSE OUTCOMES

1. Outline the basic principles of Solid waste and separation of wastes.
2. Identify the concepts of treatment of solid wastes.
3. Identify the methods of wastes disposals.
4. Examine the level of Hazardousness and its management.
5. Examine the possible of the energy production using waste materials.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNITI SOLIDWASTE

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNITII WASTETREATMENT

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNITIII WASTEDISPOSAL

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classficaition, Types, Methods &Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfillRemediation

UNITIV HAZARDOUS WASTEMANAGEMENT

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediaiton, risk assessment.

UNITV ENERGY GENERATION FROM WASTE

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, energy recovery systems. Biological & chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

SUGGESTED READINGS

1. Dara.S.S, Mishra.D.D, A Text book of Environmental chemistry and pollution control, S.Chand and company Ltd,2011
2. Nagpal H.Theisen, S. Vigil, Integrated Solid Waste management- Engg. Principles and management issues, George Tchobanoglous, McGraw Hill,2013
3. Frank Kreith, George Tchobanoglous , Hand Book of Solid Waste Management- 2ndedition, McGraw Hill Publishing Ltd., Newyork,2002
4. Shah, L Kanti, Basics of Solid & Hazardous Waste Management Technology, Prentice Hall,1999

18BESHOE06 GREENCHEMISTRY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the students conversant about the green chemistry
2. To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
3. To acquaint the student with concepts of green technology.
4. To develop an understanding of the basic concepts of renewable energy resources.
5. To acquaint the students with the basics information on catalysis.
6. To acquaint the students about the green alternate solutions.

COURSE OUTCOMES

1. Outline the basic principles of green chemistry
2. Examine the different atom efficient process and synthesis elaborately
3. Apply the concepts combustion of green technology
4. Identify and apply the concepts of renewable energy
5. Apply the concepts of green catalysts in the synthesis
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNITI INTRODUCTION TO GREEN CHEMICALPRINCIPLES

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNITII ATOM EFFICIENTPROCESSES

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis

UNITIII BIOTECHNOLOGY AND GREENCHEMISTRY

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNITIV RENEWABLERESOURCES

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomassconversion

UNITV CATALYSIS IN GREENCHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

SUGGESTED READINGS

1. Sanjay K. Sharma, AckmezMudhoo, Green Chemistry for Environmental Sustainability, CRC Press ,2010
2. V. K. Ahluwalia and M.Kidwai, New Trends in Green Chemistry, Anamaya publishers.Newdelhi. Second Edition, 2007
3. Dr. Sunita Ratan , A Textbook of Engineering Chemistry, S.K. Kataria and Sons., New Delhi.,2012
4. Mukesh Doble. Ken Rollins, Anil Kumar, Green Chemistry and Engineering, 1st edition, Academic Press, Elesevier., New Delhi.,2007
5. Desai K. R., Green Chemistry, Himalaya Publishing House, Mumbai.,2005
6. Matlack A. S., Introduction to Green Chemistry, Marcel Dekker: New York,2001

18BESHOE07 APPLIEDELECTOCHEMISTRY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the students conversant with the information on electrochemical material.
2. To make the student acquire sound knowledge of conducting polymers.
3. To acquaint the student with concepts of Energy storage devices.
4. To develop energy storage devices.
5. To impart knowledge on basic principles of solar cells and its applications
6. To study about Electro organic chemicals

COURSE OUTCOMES

1. Outline the basic principles of chemistry in electrochemical material (K)
2. Examine the properties of conducting polymers(S)
3. Apply the concepts of electrochemistry in storage devices.(S)
4. Identify the concepts of storage devices and its applications. (S)
5. Apply the suitable materials for the manufacturing of storage devices. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNITI METALFINISHING

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning

UNITII CONDUCTING POLYMERS ANDELECTROCHEMICALS

Electropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers-poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNITIII BATTERIES AND POWERSOURCES-I

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNITIV BATTERIES AND POWERSOURCES-II

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNITV ELECTROCHEMICAL MATERIALSCIENCE

Solar cells- Preparation of CdS/Cu2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

SUGGESTED READINGS

1. Cynthia G. Zoski, Hand Book of Electrochemistry, Academic Press, Elesevier., UK,2007
2. D.Pletcher and F.C.Walsh, Industrial Electrochemistry, Chapman and Hall, London,1990
3. M. Barak, Electrochemical Power Sources, I.EEE series, Peter Peregrinius Ltd, Steverage, U.K. ,1997
4. Bruno Scrosati, Applications of Electroactive Polymers, Chapman & Hall, London,1993
5. K.L. Chopra and I. Kaur, Thin Film Devices and their Application, Plenum Press, New York.,1983
6. M.M.Baizer, Organic Electrochemistry, Dekker Inc. New York,1983

18BESHOE08 **INDUSTRIALCHEMISTRY** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To make the students conversant with cement and lime and its uses.
2. To make the student acquire sound knowledge of abrasives and refractories.
3. To acquaint the student with concepts of inorganic chemicals.
4. To develop an understanding of the basic concepts explosives.
5. To acquaint the students with the basics of agriculture chemicals.
6. To acquaint the students about the use of industrial chemical as per government law.

COURSE OUTCOMES

1. Outline the basic chemistry of cement and lime
2. Examine the uses of abrasives and refractories
3. Identify the usage of the inorganic chemicals.
4. Identify the concepts of explosives and smoke screens
5. Identify the usage of the agriculture chemicals
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNITI CEMENT ANDLIME

Manufacture of Portland cement – settling of hardening of Portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydraulic lime.

UNITII ABRASIVES ANDREFRACTORIES

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

UNITIII INORGANIC CHEMICALS

Common salt and soda ash – Manufacture – Different grades – products – alkalis – Na_2CO_3, Caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage. Hydrochloric acid – manufacture – absorption – uses, Sulphur and sulphuric acid – extraction of sulphur – manufacture of H_2SO_4 – chamber – contact processes – industrialuses.

UNITIV EXPLOSIVES

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gasmask.

UNITV AGRICULTURECHEMICALS

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

SUGGESTED READINGS

1. Harikrishan, Industrial Chemistry, Goel Publishing House, Meerut.,2014
2. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut,2000
3. B.N.Chakrabarty**,** Industrial Chemistry**,** Oxford and IBH Publishing CO. New Delhi.,1998
4. James A. Kent, Hand Book of Industrial Chemistry, 9th edition, New York, Van Nostrand Reinhold.,1992
5. R.N. Sherve, Chemical process industries, McGraw-Hill, Kugakuisha Ltd., Tokyo.,1984
6. S.D. Shukla and G.N. Pandy, A text book of chemical technology, Vikas publishinghousepvt. Ltd, New Delhi.,1979

18BESHOE09 TECHNICALWRITING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

PURPOSE

It provides techniques of writing and also trains the students to write without their influence of mother tongue. In addition to honing their skills as professional writers, students will develop technical vocabularies that will aid writing research articles and discussing articles produces by their peers.

COURSE OBJECTIVES

1. Develop abilities to write technically and expressively,
2. Recognize writing as a constructive, meaningful process,
3. Practice using reading strategies for effective writing.
4. Design effective technical documents for both print and digital media
5. Identify the qualities of good technical writing
6. To lean avoiding similarity index.

COURSE OUTCOMES

1. Construct simple sentences, correct common grammatical errors in written English.
2. Develop confidence in English language by imbibing lexical and syntax rules.
3. Enrich their reading ability for effective writing.
4. Elevate them to minimize word, sentence, and paragraph length without sacrificing clarity or substance
5. Familiarize with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
6. Demonstrate the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

UNITI BASICS OFWRITING

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer's block – Prioritizing for effective writing– Avoiding plagiarism.

UNITII PARAGRAPHS ANDESSAYS

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

UNITIII LETTERS, MEMOS ANDEMAIL

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

UNITIV THE ART OF CONDENSATION AND TECHNICALPROPOSALS

StepstoEffectivepréciswriting–Guidelines–TechnicalProposals–TypesofProposals–Characteristics–
Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /FilmReview – Travelogue – DialogueWriting.

UNITV REPORTS AND RESEARCH ARTICLES

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

SUGGESTED READINGS

1. V.N. Arora & Lakshmi Chandra, Improve Your Writing: Revised First Edition, OUP,2014
2. Crème, P. and M. Lea., Writing at University: A guide for students., OUP,2003
3. Graham King, Collins Improve Your Writing, Collins; First edition ,2009
4. David Morley, The Cambridge Intro. To Creative Writing, Cambridge,2008

COMPUTER SCIENCE AND ENGINEERING

18BECSOE01 INTERNETPROGRAMMING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study concepts of Internet, IP addresses and protocols
2. To explain the concept of web page development through HTML
3. To introduce the PERL and explore its current strengths and Weaknesses
4. To write working Java code to demonstrate the use of applets for client side programming
5. To study Internet telephony and various multimedia applications
6. To Elaborate on the principles of web page development

COURSE OUTCOMES

Upon completion of this course, the student will be able to:

1. Learn the advanced concepts& techniques of Internet and Java.
2. Analyze the requirements for and create and implement the principles of web page development
3. Understand the concepts of PERL
4. Implement client side programming using java applets
5. Generate internet telephony based upon advanced concepts
6. Develop applications on internet programming based on java applets and scripts

UNITI INTRODUCTION

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNITII HTML

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods

UNITIII PERL

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets-Container Class, Components, Applet Life Cycle, Update method,Applications

UNITIV CLIENT-SERVERPROGRAMMING

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNITV INTERNETTELEPHONY

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP-Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

SUGGESTED READINGS

1. Paul Deitel, Harvey Deitel& Abby Deitel, Internet and World Wide Web-How to Program, PHI Learning, Delhi,2011
2. N.P. Gopalan and J. Akilandeswari, Web Technology: A Developer's Perspective, PHI Learning, Delhi,2013
3. Rahul Banerjee, Internetworking Technologies, An Engineering Perspective, PHI Learning, Delhi,2011
4. Robert W. Sebesta, Programming the World Wide Web, Pearson Education,2016

18BECSOE02 MULTIMEDIAANDANIMATION 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart the fundamental concepts of Computer Animation and Multimedia
2. To study the graphic techniques and algorithms using flash
3. Explain various concepts available in 3D animation
4. Explain various devices available for animation
5. To study the multimedia concepts and various I/O technologies for concept development
6. To understand the three-dimensional graphics and their transformations

COURSE OUTCOMES

1. Develop their creativity using animation and multimedia
2. Understand the concepts of Flash and able to develop animation using it
3. Understand about various latest interactive 3D animation concepts
4. Know the various devices and software available in motion capture
5. Understand the concept development process
6. Develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.

UNITI INTRODUCTION

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

UNITII CREATING ANIMATION INFLASH

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Action script.

UNITIII 3D ANIMATION & ITSCONCEPTS

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation

UNITIV MOTIONCAPTION

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

UNITV CONCEPTDEVELOPMENT

Story Developing –Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

SUGGESTED READINGS

1. Malay K. Pakhira, Computer Graphics, Multimedia and Animation, PHI Learning,2010
2. Ranjan Parekh, Principles of Multimedia, TMH,2007
3. Ashok Banerji, Ananda Mohan Ghosh, Multimedia Technologies, McGraw Hill Publication,2007
4. Pankaj Dhaka, Encyclopedia of Multimedia and Animations, Anmol Publications,2011

18BECSOE03 PC HARDWARE ANDTROUBLESHOOTING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study the basic parts of computer in detail
2. Introduce various peripheral devices available for computer and its detailed working concepts
3. Overview of various interfaces and other hardware overview
4. Assemble/setup and upgrade personal computer systems and discuss about power supplies and the skills to trouble-shoot various power-related problems.
5. To study basic concepts and methods in troubleshooting
6. To study the installation/connection and maintenance of computer and its associated peripherals.

COURSE OUTCOMES

1. Identify the main components for the PC, familiarize themselves with PC memories such as RAM and ROM devices and so on.
2. Identify various peripheral devices available and its working
3. Understand various concepts of hardware and its interface and control
4. Perform basic installation of PC. Importance of maintenance is understood
5. Understand Various faults and failures are identified and troubleshooting in detail
6. Understand overall PC hardware, interfacing, maintenance and troubleshooting

UNITI INTRODUCTION

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques – Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC andUser.

UNITII PERIPHERALDEVICES

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

UNITIII PC HARDWAREOVERVIEW

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

UNITIV INSTALLATION AND PREVENTIVEMAINTENANCE

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – DataRecovery.

UNITV TROUBLESHOOTING

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROMProblems.

SUGGESTED READINGS

1. B. Govindarajalu, IBM PC Clones Hardware, Troubleshooting and Maintenance, TMH,2002
2. Peter Abel, Niyaz Nizamuddin, IMB PC Assembly Language and Programming, Pearson Education,2007
3. Scott Mueller, Repairing PC's, PHI,1992

18BECSOE04 **JAVAPROGRAMMING** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand Object Oriented Programming concepts and basic characteristics of Java
2. To know the principles of packages, inheritance and interfaces
3. To define exceptions and use I/O streams
4. To develop a java application with threads, generics classes and swings
5. To explain the need for generic programming
6. To design and build simple Graphical User Interfaces

COURSE OUTCOMES

1. Develop Java programs using OOP principles
2. Develop Java programs with the concepts inheritance and interfaces
3. Build Java applications using exceptions and I/O streams
4. Develop Java applications with threads and generics classes and swings
5. Understand various aspects for motivation of generic programming
6. Develop various interactive Java programs using OOP concepts of Java

UNITI INTRODUCTION TO JAVA

Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism.- Objects and classes in Java – defining classes – methods - access specifiers – static members –constructors – finalizemethod

UNITII PACKAGES

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy –polymorphism – dynamic binding – final keyword – abstract classes

UNITIII I/OSTREAMS

The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/O Streams - Graphics programming – Frame – Components – working with 2D shapes

UNITIV EXCEPTIONHANDLING

Exceptions – Syntax of exception handling code – Multiple catch statements – Using finally statements – Throwing our own exceptions – Using exceptions for debugging

UNITV THREADS

Introduction, Creating Threads, The Life Cycle of a Thread, Thread Methods, Using Threads, Synchronization of Threads, Summary

SUGGESTED READINGS

1. Cay S. Horstmann and Gary Cornell, Core Java: Volume I – Fundamentals Sun Microsystems, Press,2008
2. K. Arnold and J. Gosling, The JAVA programming language, Pearson Education,2009
3. Timothy Budd, Understanding Object-oriented programming with Java Updated Edition, Pearson Education,2002
4. C. Thomas Wu, An introduction to Object-oriented programming with Java Fourth Edition, Tata McGraw-Hill Publishing company Ltd,2008

ELECTRICAL AND ELECTRONICS ENGIEERING

18BEEEOE01 ELECTRICHYBRIDVEHICLES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the basic concepts of electric hybrid vehicle.
2. To gain the knowledge about electric propulsion unit.
3. To gain the concept of Hybrid Electric Drive-Trains.
4. To gain the different Energy Management Strategies.
5. To study about the efficiency manipulation in drives
6. To understand and gain the knowledge about various energy storage devices

COURSE OUTCOMES

1. Summarize the basic concepts in bioprocess Engineering.
2. Explain the concept of Hybrid Electric Vehicles.
3. Understand the concept of Hybrid Electric Drive-Trains.
4. Identify the different Energy Management Strategies.
5. Understand the concept of different Energy Storage devices.
6. Analyze the different motor drives used in Hybrid Electric Vehicles.

UNITI INTRODUCTION

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNITII HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNITIII ELECTRIC PROPULSIONUNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNITIV ENERGYSTORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNITV ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,2010
2. Mehrdad Ehsani, Yimi Gao, Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,2009
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley,2012

18BEEEOE02 ENERGY MANAGEMENT ANDENERGYAUDITING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To gain the knowledge about energy management.
2. To understand the basic concepts in economic analysis in energy management.
3. To understand the basic principles of energy audit.
4. To gain the knowledge about the basic concept of types of Energy Audit
5. To gain and Evaluate the different energy efficient motors
6. Understand the concept of Energy conservation.

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability to

1. Understand the concept of Energy Management.
2. Analyze the different methods for economic analysis
3. Knowledge about the basic concept of Energy Audit and types.
4. Evaluate the different energy efficient motors
5. Understand the concept of Energy conservation.
6. Investigate the different methods to improve power factor.

UNITI ENERGYMANAGEMENT

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

UNITII ECONOMIC ASPECTS ANDANALYSIS

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

UNITIII BASIC PRINCIPLES OF ENERGYAUDIT

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNITIV ENERGY EFFICIENTMOTORS

Electric Motors: Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

Energy conservation: Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

UNITV POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGYINSTRUMENTS

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice- lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application ofPLCs.

SUGGESTED READINGS

1. Murphy W.R. and G.Mckay Butter worth, Energy Management, Heinemann Publications,2007
2. John.C.Andreas, Energy Efficient Electric Motors, Marcel Dekker Inc Ltd – 3rd edition,2005
3. W.C.Turner Steve Doty, Energy Management Handbook, John Wiley and Sons, 7th Edition,2013

18BEEEOE04 PROGRAMMABLELOGICCONTROLLER 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the basic principles of PLC systems.
2. To gain the knowledge about data handling functions.
3. To gain the knowledge of storage techniques in PLC
4. To acquire the knowledge about how to handle the data and functions
5. To study about flow charts of ladder and spray process system
6. To understand the principles of PID.

COURSE OUTCOMES

1. At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.
2. To acquire the knowledge of storage techniques in PLC
3. Students know how to handle the data and functions
4. Students known about advanced controller in PLC applications
5. Students gather real time industrial application of PLC
6. Students gathered and evaluate the flow charts of ladder and spray process system

UNITI INTRODUCTION

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNITII PLCPROGRAMMING

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNITIII REGISTERS AND PLC FUNCTIONS

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNITIV DATA HANDLINGFUNCTIONS

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrixfunctions.

UNITV PIDPRINCIPLES

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing, analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

SUGGESTED READINGS

1. JR Hackworth and F.D Hackworth – Jr, Programmable Logic Controllers – Programming Method and Applications, Pearson,2006
2. John Webb and Ronald A Reiss, Programmable Logic Controllers – Principle and Applications, Fifth edition, PHI,2004
3. W.Bolton, Programmable Logic controller, Elsevier Newnes Publications, Fourth Edition,2009

18BEEEOE04 RENEWABLEENERGYRESOURCES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To gain the knowledge about environmental aspects of energy utilization.
2. To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
3. To study about solar energy collectors and its storages
4. To study about the inter connected system in wind power
5. To understand the basic principles fuel cell, Geo thermal power plants.
6. To gain the knowledge about hydro energy.

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability to

1. Analyze the Energy Scenario in india
2. Understand the concept of Solar Energy
3. Understand the concept of Wind Energy
4. Understand the concept of Hydro Energy
5. Analyze the different energy sources
6. Students gathered the real time inter connected system modelling in wind power

UNITI INTRODUCTION

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

UNITII SOLARENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNITIII WINDENERGY

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNITIV HYDROENERGY

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNITV OTHERSOURCES

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS

1. Rai.G.D, Non-conventional resources of energy, Khanna publishers ,Fourth edition,2011
2. Khan.B.H, Non-Conventional Energy Resources, The McGraw Hills, Second edition,2009
3. Rao.S. &Parulekar, Energy Technology, Khanna publishers, Fourth edition,2013
4. Godfrey Boyl, Renewable Energy: Power sustainable future, Oxford University Press, Third edition,2012
5. John W Twidell and Anthony D Weir, Renewable Energy Resources, Taylor and Francis,2015

ELECTRONICS AND COMMUNICATION ENGINEERING

18BEECOE01 REAL TIMEEMBEDDEDSYSTEMS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce students to the embedded systems, its hardware and software.
2. To introduce devices and buses used for embedded networking.
3. To study about task management
4. To learn about semaphore management and message passing
5. To study about memory management
6. To understand and gain the knowledge about various energy storage devices

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand overview of embedded systems architecture
2. Acquire knowledge on embedded system, its hardware and software.
3. Gain knowledge on overview of Operating system
4. Discuss about task Management
5. Gain knowledge about semaphore management and message passing.
6. Gain knowledge about memory management

UNITI INTRODUCTION TO EMBEDDEDSYSTEM

Introduction - Embedded systems description, definition, design considerations & requirements - Overview of Embedded system Architecture (CISC and RISC) - Categories of Embedded Systems - embedded processor selection &tradeoffs - Embedded design life cycle - Product specifications - hardware/software partitioning - iterations and implementation - hardware software integration - product testing techniques – ARM 7

UNITII OPERATING SYSTEMOVERVIEW

Introduction –Advantage and Disadvantage of Using RTOS – Multitasking – Tasks - Real Time Kernels – Scheduler - Non-preemptive Kernels - Preemptive Kernels – Reentrancy- Reentrant Functions – Round Robin Scheduling - Task Priorities - Static Priorities – Mutual Exclusion – Deadlock – Intertask Communication – Message Mailboxes – Message Queues - Interrupts - Task Management – Memory Management - Time Management – Clock Ticks.

UNITIII TASK MANAGEMENT

Introduction - µ C/OS-II Features - Goals of µ C/OS-II - Hardware and Software Architecture – Kernel Structures: Tasks –Task States – Task Scheduling – Idle Task – Statistics Task – Interrupts Under µ C/OS-II – Clock Tick - µ C/OS-II Initialization. Task Management: Creating Tasks – Task Stacks – Stack Checking – Task's Priority – Suspending Task – Resuming Task. Time Management: Delaying a Task – Resuming a Delayed Task – System Time. Event Control Blocks- Placing a Task in the ECB Wait List – Removing a Task from an ECB waits List.

UNITIV SEMAPHORE MANAGEMENT AND MESSAGEPASSING

Semaphore Management: Semaphore Management Overview – Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox – Deleting Mailbox – Waiting for a Message box – Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue – Deleting a Message Queue – Waiting for a Message at a Queue – Sending Message to a Queue – Flushing a Queue

UNITV MEMORYMANAGEMENT

Memory Management: Memory Control Blocks – Creating Partition- Obtaining a Memor y Block – Returning a Memor y Block .Getting Started with µ C/OS-II – Installing µ C/OS-II – Porting µ C/OS-II: Development Tools – Directories and Files – Testing a Port - IAR Workbench with µ C/OS-II - µ C/OS-II Porting on a 8051 CPU – Implementation of Multitasking - Implementation of Scheduling and Rescheduling – Anal yze the Multichannel ADC with help of µ C/OS-II

SUGGESTED READINGS

1. Floyd JeanJ. LabrosseMicro C/OS–II The Real Time Kernel CMPBOOKS2009
2. David Seal ARM Architecture Reference Manual.Addison-Wesley2008
3. Steve Furbe, ARM System-on-Chip Architecture, Addison-Wesley Professional, California2000.
4. K.V.K.K.Prasad Embedded Real-Time Systems: Concepts, Design &Programming Dream Tech Press2005.
5. Sriram V Iyer, Pankaj Gupta Embedded Real Time Systems Programming Tata Mc GrawHill 2004

18BEECOE02 CONSUMERELECTRONICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study about various speakers and microphone
2. To learn the fundamental of television systems and standards
3. To learn the process of audio recording and reproduction
4. To study various telephone networks
5. To discuss about the working of home appliances
6. To familiarize with TV services like ISDN.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand working of various type of loud speakers
2. Acquire knowledge on various types of picture tubes
3. Demonstrate the working of various optical recording systems
4. Distinguish various standards for color TV system
5. Acquire knowledge on various telecommunication networks
6. Demonstrate the working of various home appliances

UNITI LOUDSPEAKERS ANDMICROPHONES

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones

UNITII TELEVISION STANDARDS ANDSYSTEMS

Components of a TV system – interlacing – composite video signal. Colour TV – Luminance and Chrominance signal; Monochrome and Colour Picture Tubes - Colour TV systems – NTSC, PAL, SECAM - Components of a RemoteControl

UNITIII OPTICAL RECORDING ANDREPRODUCTION

Audio Disc – Processing of the Audio signal –read out from the Disc – Reconstruction of the audio signal – Video Disc – Video disc formats- recording systems – Playback Systems

UNITIV TELECOMMUNICATIONSYSTEMS

Telephone services - telephone networks – switching system principles – PAPX switching – Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellularmodems

UNITV HOME APPLIANCES

Basic principle and block diagram of microwave oven; washing machine hardware and software; components of air conditioning and refrigeration systems.

SUGGESTED READINGS

1. S.P. Bali Consumer Electronics Pearson Education2007
2. J.S.ChitodeConsumer Electronics Technical Publications2007
3. Philip Hoff, Philip Herbert Hoff Consumer Electronics for Engineers Cambridge University Press 1998

18BEECOE03 NUERAL NETWORK ANDITSAPPLICATIONS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce the basic concepts of neural networks and its applications in various domain
2. To educate how to use Soft Computing to solve real-world problems
3. To have a solid understanding of Basic Neural Network.
4. To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
5. To gain exposure in the field of neural networks and relate the human neural system into the digital world
6. To provide knowledge of computation and dynamical systems using neural networks.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basic concepts of neural networks and its applications in variousdomains
2. Gain knowledge about learning process in NeuralNetworks
3. Apply perception concept indesign
4. Design using ARTphenomena
5. Gain knowledge on SOMconcepts
6. Ability to develop the use of Soft Computing to solve real-worldproblems

UNITI INTRODUCTION TO NEURALNETWORKS

Introduction - biological neurons and their artificial models - learning, adaptation and neural network's learning rules - types of neural networks- single layer, multiple layer- feed forward, feedback networks

UNITII LEARNINGPROCESS

Error – correction learning – memory based learning - hebbian learning-competitive learning-Boltzmann learning- supervised and unsupervised learning-adaptation-statistical learning theory.

UNITIII PERCEPTION

Single layer perception-Adaptive filtering-unconstrained optimization-Least-mean square algorithm-Leaning curve-Annealing Technique-perception convergence theorem-Relationship between perception and Baye's classifier-Back propagation algorithm

UNITIV ATTRACTOR NEURAL NETWORK AND ART

Hopfield model-BAM model- BAM stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield design-Application to TSP problem-ART- layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP

UNITV SELFORGANIZATION

Self organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical vector Quantization. Applications of self-organizing maps: The Neural Phonetic Typewriter Learning Ballistic Arm Movements

SUGGESTED READINGS

1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications PHI, New Delhi2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/PrenticeHall 1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold1989.
6. Freeman J.A, Skapura D.M Neural networks, algorithms, applications, and programming techniques AdditionWesley2005.

18BEECOE04 FUZZY LOGIC ANDITSAPPLICATIONS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To introduce the basic concepts of Fuzzy logic and its applications in various domain
2. To educate how to use Fuzzy computation to solve real-world problems
3. To have a solid understanding of Basic fuzzy models.
4. Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
5. To learn about applications on Fuzzy based systems
6. To familiarize with fuzzy fiction and de fuzzy fiction procedures

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand the basic concepts of Fuzzy logic and its applications in variousdomain
2. Gain knowledge on theory ofReasoning
3. Develop fuzzycontrollers
4. Understand concepts of adaptive fuzzycontrol
5. Ability to develop how to use Fuzzy computation to solve real- worldproblems
6. Design fuzzy based model for anyapplication

UNITI BASICS OF FUZZYLOGIC

Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

UNITII THEORY OF APPROXIMATE REASONING

Linguistic variables, Fuzzy proportions, Fuzzy if- then statements, inference rules, compositional rule of inference-fuzzy models

UNITIII FUZZY KNOWLEDGE BASED CONTROLLERS(FKBC)

Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzyfication and defuzzyfication procedures – Design of Fuzzy Logic Controller

UNITIV ADAPTIVE FUZZYCONTROL

Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model based controller.

UNITV FUZZY BASED SYSTEMS

Simple applications of FKBC -washing machines- traffic regulations -lift control-fuzzy in medical applications- Introduction to ANFIS.

SUGGESTED READINGS

1. D .Diankar ,H. Hellendoom and M .Rein frank An Introduction to Fuzzy Control NarosaPublishers India 1996
2. G.J. KlirandT.A. Folger Fuzzy Sets Uncertainty and Information PHI IEEE1995
3. Timothy J. Ross Fuzzy Logic with Engineering ApplicationsMcGrawHill 1997
4. George. J Klir and Bo Yuan Fuzzy Sets and Fuzzy Logic Prentice Hall, USA1995

18BEECOE05 PRINCIPLES OF MODERNCOMMUNICATION SYSTEM 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To provide students with an overview of communication systems
2. To provide an overview on mobile communication
3. To make students to have a better understanding on satellite and radar communication
4. To understand the basic communication techniques which in turn are used as the building blocks of the larger and more complex communication systems.
5. To acquire the basic engineering understanding to the modern communication systems and; the relevant theory and technique.
6. Design simple systems for landing and navigation.

COURSE OUTCOMES

At the end of the course the students will be able to

1. Understand past, present and future trends in mobile communication.
2. Gain knowledge about mobile cellular communication
3. Understand various standards in use for wireless communication and its application.
4. Demonstrate some basic application of GPS.
5. Gain knowledge about RADAR working and its applications
6. Demonstrate how a simple radar system works and its applications.

UNITI THE EVOLUTION OF ELECTRONICCOMMUNICATION

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNITII MOBILE CELLULARCOMMUNICATIONS

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNITIII WIRELESSCOMMUNICATION

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNITIV SATELLITECOMMUNICATION

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNITV RADAR &NAVIGATION

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system-Modern Navigationsystems.

SUGGESTEDREADINGS

1. S.Haykin, ―Communication Systems, 4/e, John Wiley2007
2. B.P.Lathi, ―Modern Digital and Analog Communication Systems, 3/e, Oxford UniversityPress,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson Education India, 2010
4. Vijay. K. Garg, ―Wireless Communication and Networking, Morgan Kaufmann Publishers,2007.
5. T.Pratt, C. Bostian and J.Allnutt; ―Satellite Communications, John Wiley and Sons, SecondEdition., 2003
6. M. I .Skolnik ―Introduction to Radar Systems, Tata McGraw Hill2006.
7. Myron Kyton and W.R.Fried ―Avionics Navigation Systems, John Wiley & Sons1997.

BIOTECHNOLOGY

18BTBTOE01 BIOREACTORDESIGN 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart basic knowledge in bioprocessEngineering
2. To design the bioreactors for variousoperations.
3. To understand the principle and working of heat transferequipments.
4. To extend the knowledge in principle of heat transfer inside abioreactor
5. To construct the equipments used in mass transferoperations.
6. To learn the equipments used in separationprocess.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Summarize the basic concepts in bioprocessEngineering.
2. Design the bioreactors for variousoperations.
3. Understand the principle and working of heat transferequipments.
4. Develop the heat transfer equipments for BioprocessEngineering.
5. Construct the equipments used in mass transferoperations.
6. Categorize the equipments used in separationprocess.

UNITI ENGINEERING PROPERTIES AND STORAGETANK

Introduction to various mechanical properties of material to be used material of construction, design of cylindrical storage tank.

UNITII REACTORDESIGN

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNITIII HEAT TRANSFEREQUIPMENTS

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulationevaporator.

UNITIV MASS TRANSFEREQUIPMENTS

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNITV SEPERATIONEQUIPMENTS

Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotart drum drier and Swenson –walker crystallizer.

SUGGESTED READINGS

1. James Edwin Bailey, DavidF.Ollis, Biochemical Engineering Fundamentals, McGraw- Hill,2015
2. DonW.Green,RobertH. Perry, Chemical Engineer Handbook, The McGraw- Hill Companies, Inc.,2008
3. Pauline. M. Doran, Bioprocess Engineering Principles, Academic Press,2015.

18BTBTOE02 FOOD PROCESSINGANDPRESERVATION 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To learn the scope and importance of foodprocessing.
2. To impart basic knowledge in different food processing methods carried out in the food techcompanies.
3. To extend the brief knowledge in food conservationoperations.
4. To study the methods of food preservation bycooling.
5. To familiarize the students on the concepts of preservation methods forfruits.
6. To create deeper understanding on preservation methods forvegetables.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Describe the scope and importance of foodprocessing.
2. Outline the various processing methods forfoods.
3. Extend the knowledge in food conservationoperations.
4. Describe the methods of food preservation bycooling.
5. Summarize the preservation methods forfruits.
6. Demonstrate the preservation methods forvegetables.

UNITI SCOPE AND IMPORTANCE OF FOODPROCESSING

Properties of food - Physical, thermal, mechanical, sensory. Raw material Preparation - Cleaning, sorting, grading, peeling.

UNITII PROCESSINGMETHODS

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning- additives fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing- Concepts and equipmentused.

UNITIII FOOD CONVERSIONOPERATIONS

Size reduction- Fibrous foods, dry foods and liquid foods- Theory and equipments- membrane separation- filtration- equipment andapplication.

UNITIV FOOD PRESERVATION BYCOOLING

Refrigeration, Freezing-Theory, freezing time calculation, methods of freezing, freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control wateractivity.

UNITV PRESERVATION METHODS FOR FRUITS ANDVEGETABLES

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification,preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

SUGGESTED READINGS

1. R.PaulSingh,DennisR. Heldman, Introduction to food engineering., Academic Press,2014
2. P.Fellows., Food Processing Technology, Principles and practice., Woodhead Publishing Ltd,2017
3. MirceaEnachescuDauthy, Fruit and Vegetable Processing, FAO agricultural services bulletin no.119,1995
4. M.A. Rao, Syed S.H. Rizvi,AshimK.Datta, Engineering properties offoods, CRC Press,2014
5. B.Sivasankar, Food processing and preservation, PHI Learning Pvt.Ltd,2002

18BTBTOE03 BASICBIOINFORMATICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the available tools and databases for performing research inbioinformatics.
2. To expose students to sequence alignment tool inbioinformatics.
3. To construct the phylogenetic trees forevolution.
4. To get familiar with the 3D structure of protein andclassification.
5. To acquire basic knowledge in protein secondary structureprediction.
6. To extend the brief knowledge in Micro array dataanalysis.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Summarize the basic concepts and importance of Bioinformatics in varioussectors.
2. Demonstrate the sequence alignment tool inbioinformatics.
3. Construct the phylogenetic trees forevolution.
4. Analyze the three dimensional protein structure and classification using varioustools.
5. Illustrate the protein secondary structure prediction by comparativemodeling.
6. Extend the knowledge in micro array technology and applications of bioinformatics in varioussectors.

UNITI OVERVIEW OFBIOINFORMATICS

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

UNITII RETRIEVAL OF BIOLOGICALDATA

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system).Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

UNITIII PHYLOGENETICS

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

UNITIV STRUCTURALBIOINFORMATICS

Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & prediction strategies.

UNITV MICROARRAY DATA ANALYSIS

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharma informatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

SUGGESTED READINGS

1. Dan E. Krane, Michael L. Rayme, Fundamental Concepts of Bioinformatics, Pearson education,2004
2. Andreas D., F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience,2004
3. David W. Mount, Sequence and Genome Analysis, Cold Spring Harbor Laboratory,2004
4. Jonathan Pevsner, Bioinformatics and Functional Genomics, Wiley-Liss,2015
5. Michael J. Korenberg, Microarray Data Analysis: Methods and Applications, Humana Press,2016.

18BTBTOE04 FUNDAMENTALS OFNANOBIOTECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart the skills in the field of nano biotechnology and itsapplications.
2. To acquire knowledge in the nano particles and its significance in variousfields.
3. To extend the knowledge in types and application of nano particles insensors.
4. To define the concepts of biomaterials through molecular selfassembly.
5. To equip students with clinical applications of nanodevices.
6. To describe deeper understanding of the socio-economic issues innanobiotechnology.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Develop skills in the field of nano biotechnology and itsapplications.
2. Summarize the nanoparticles and its significance in variousfields.
3. Extend the knowledge in types and application of nano particles insensors.
4. Define the concepts of biomaterials through molecular selfassembly.
5. Outline the clinical applications of nanodevices.
6. Describe the socio-economic issues innanobiotechnology.

UNITI INTRODUCTION

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

UNITII NANOPARTICLES

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrication's-MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNITIII APPLICATIONS

Nanomedicine, Nanobiocensor and Nanofludics.Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems.Nano-Biodevices and Systems.Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNITIV NANOBIOTECHNOLOGY

Clinical applications of nanodevices.Artificialneurons.Real-time nanosensors- Applications in cancer biology.Nanomedicine.Synthetic retinyl chips based on bacteriorhodopsins.High throughput DNA sequencing with nanocarbon tubules.Nanosurgical devices.

UNITV ETHICAL ISSUES INNANOTECHNOLOGY

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

SUGGESTED READINGS

1. Niemeyer. C.M. and Mirkin. C.A, Nanobiotechnology: Concepts, Applications and Perspectives, Wiley- VCH,2005
2. Goodsell. D.S., Bionanotechnology, John Wiley and Sons, Inc,2004
3. Shoseyov. O., Levy. I, Nanobiotechnology: Bioinspired Devices and Materials of the Future, Humana Press,2008
4. Bhushan. B., Springer Handbook of Nanotechnology, Springer- Verlag Berlin Heidelberg,2017
5. FreitasJr R.A, Nanomedicine, Landes Biosciences,2006
6. Kohler. M. and Fritzsche. W., Nanotechnology – An Introduction to Nanostructuring Techniques, Wiley- VCH,2008

AUTOMOBILE ENGINEERING

18BEAEOE01 AUTOMOBILEENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart knowledge on the constructional details and principle of operation of various automobile components.
2. To learn the function and working of various components in transmission and drive lines.
3. To study the concept and working of steering and suspension systems in an automobile.
4. To give knowledge on the wheels, tyres and brakes of automobiles.
5. To provide information on the current and future trends in automobiles.
6. Identify and explain the types of steering system..

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

1. Demonstrate the operating principles and constructional details of various automobile components.
2. Explain the function and working of components in transmission and drive lines.
3. Identify and explain the types of steering system.
4. Identify and explain the types of suspension system.
5. Classify and describe the types of wheels, tyres and brakes of automobiles.
6. Discuss the current and future trends in the automobiles

UNITI ENGINE AND AUXILIARYSYSTEMS

Classification of engines – construction and working of four-stroke spark ignition (SI) engine and compression ignition (CI) engine – construction and working of two-stroke SI and CI engine – firing order – carburettor – fuel injection systems – battery – dynamo – alternator – starting motor – lighting system – ignition system.

UNITII TRANSMISSIONSYSTEMS

Requirements of transmission system – flywheel – clutch – types of clutch – construction of single and multi-plate clutches – need, types and construction of transmission gear box – universal joint – propeller shaft – need, types and construction of differential – four wheeldrive.

UNITIII STEERING AND SUSPENSIONSYSTEMS

Principle of steering – steering linkages – types of steering gear box –power steering – suspension systems – need and types – independent suspension – coil spring, leaf spring, torsion bar and air suspension – shock absorbers.

UNITIV WHEELS ANDBRAKES

Wheels and tyres – construction – types and specifications – tyre wear and causes – brakes – need – braking distance – types – mechanical, hydraulic and pneumatic brakes – power brake – parking brake – redundant braking system.

UNITV CURRENT AND FUTURETRENDS

Anti-lock Braking System (ABS) – brake assist – Electronic Brakeforce Distribution (EBD) – airbags – automatic high-beam control – backup cameras – defogger – electric vehicles – hybrid vehicles – autonomous vehicles – vehicle-to-vehicle communication – vehicle tracking – alternative fuels.

SUGGESTED READINGS:

1. Kirpal Singh, *Automobile Engineering Volume 1*, Standard Publishers, New Delhi,2018.
2. Sethi H M, *Automobile Technology*, Tata McGraw-Hill, New Delhi,2003.
3. William H Crouse and Donald L Anglin, *Automotive Mechanics*, Tata McGraw-Hill, New Delhi,2006.
4. Srinivasan S, *Automotive Mechanics*, Tata McGraw-Hill, New Delhi,2003.
5. Ganesan V, *Internal Combustion Engines*, McGraw-Hill Education, New Delhi,2012.

18BEAEOE02 TWO AND THREEWHEELERTECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.
2. Construct the frames of two and three wheelers of different layouts.
3. Demonstrate the constructional details and principle of operation of various engine components.
4. Identify and explain the types of transmission systems.
5. Identify and explain the types of steering and suspension systems.
6. Classify and describe the types of wheels, tyres and brakes for two and three wheelers.

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

1. Construct the frames of two and three wheelers of different layouts.
2. Demonstrate the constructional details and principle of operation of various engine components.
3. Identify and explain the types of transmission systems.
4. Identify and explain the types of steering and suspension systems.
5. Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
6. Explain the servicing of two and three wheelers.

UNITI INTRODUCTION

History of two and three wheelers – classification and layouts of two wheelers – classification and layouts of three wheelers – main frame for two wheelers and types – main frame for three wheelers and types.

UNITII INTERNAL COMBUSTIONENGINES

Classification of engines – selection criteria of engine for two and three wheelers – design considerations for two and three wheeler engines – construction and working of two-stroke and four-stroke engines – fuel feed system – lubricating system – cooling system – scavenging system – cranking system – kick start and auto-start mechanisms.

UNITIII TRANSMISSION, STEERING AND SUSPENSIONSYSTEMS

Clutch – single plate, multiple plate and centrifugal clutches – primary reduction – gear box – gear shifting mechanisms – automatic transmission – final drive and differential for three wheelers – steering geometry – steering column construction – steering system for three wheelers – front and rear suspension systems – spring and shock absorber assembly.

UNITIV WHEELS, TYRES ANDBRAKES

Spoked wheels, pressed steel wheels and alloy wheel – tyre construction – tyre with tube and tubeless tyre – theory of brake action – drum and disc brakes – brake links layout for front and rear wheels – mechanical and hydraulic brake control systems – anti-lock braking system.

UNITV TWO AND THREE WHEELERS CASESTUDY

Case study of mopeds, scooters, motor cycles, sports bikes, auto rickshaws, pickup vans, delivery vans and trailers – servicing – factors affecting fuel economy and emission.

SUGGESTED READINGS:

1. Dhruv U Panchal, *Two and Three Wheeler Technology*, PHI Learning, New Delhi,2015.
2. Ramalingam K K, *Two Wheelers and Three Wheelers: Theory, Operation and Maintenance*, Scitech Publications, Chennai,2017.
3. Irving P E, *Motorcycle Engineering*, Veloce Enterprises, USA,2017.
4. Dennis Bailey and Keith Gates, *Bike Repair and Maintenance for Dummies*, John Wiley & Sons, USA, 2009.

18BEAEOE03 **VEHICLEMAINTANENACE** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. The objective of this course is to make the students to know and understand the maintenance and fault diagnosis of basic systems inAutomobile.
2. Describe and differentiate the types of maintenance.
3. List the procedure for dismantling, servicing and assembling of engine components.
4. Demonstrate the servicing of transmission and driveline components.
5. Discuss the procedure for steering and suspension
6. Discuss the procedure for wheel and brake maintenance.

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

1. Describe and differentiate the types of maintenance.
2. List the procedure for dismantling, servicing and assembling of engine components.
3. Demonstrate the servicing of transmission and driveline components.
4. Discuss the procedure for steering and suspension
5. Discuss the procedure for wheel and brake maintenance.
6. Explain the fault diagnosis in the electrical and air conditioner systems

UNITI MAINTENANCE OF RECORDS ANDSCHEDULES

Need for maintenance – preventive and breakdown maintenance – requirements of maintenance – preparation of check lists – inspection schedule – maintenance of records, log sheets and other forms – safety precautions in maintenance – workshop layout, tools andequipment.

UNITII ENGINE AND ENGINE SUBSYSTEMMAINTENANCE

General engine service – dismantling of engine components – engine repair – service of basic engine parts, cooling and lubricating system, fuel system, intake and exhaust system – engine tune-up.

UNITIII TRANSMISSION AND DRIVELINEMAINTENANCE

General checks, adjustment and service of clutch – dismantling, identifying, checking and reassembling transmission, transaxle – road testing – removing and replacing propeller shaft – servicing of cross and yoke joint, and constant velocity joint – rear axle service points – removing axle shaft and bearings – servicing differential assemblies – fault diagnosis.

UNITIV STEERING, SUSPENSION, WHEEL AND BRAKEMAINTENANCE

Inspection, maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering, worm type steering, power steering system – inspection, maintenance and service of MacPherson strut, coil spring, leaf spring, shock absorbers – wheel alignment and balance – removing and fitting of tyres – tyre wear and tyre rotation – inspection, maintenance and service of hydraulic brake, drum brake, disc brake, parking brake – bleeding ofbrakes.

UNITV ELECTRICAL AND AIR CONDITIONERMAINTENANCE

Maintenance of batteries, starting system, charging system and body electrical – fault diagnosis using scan tools – maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator – replacement of hoses – leak detection – air conditioner charging – fault diagnosis – vehicle body repair like panel beating, tinkering, soldering, polishing,painting.

SUGGESTED READINGS:

1. Tim Gilles, *Automotive Service: Inspection, Maintenance, Repair*, Cengage Learning, USA,2015.
2. Philip Knott and Adam Roylance, *An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles*, EMS Publishing, UK,2010.
3. James D Halderman and Curt Ward, *Advanced Engine Performance Diagnosis*, Pearson, USA,2016.
4. Ed May and Les Simpson, *Automotive Mechanics Volume 1*, McGraw-Hill Australia,2006.
5. James E Duffy, *Modern Automotive Technology*, Goodheart-Willcox, USA,2017.
6. Service manuals of variousOEMs.

18BEAEOE04 MODERNVEHICLETECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart knowledge on trends in the vehicle power plants.
2. To learn the various advanced driver assistance systems.
3. To study the working of advanced suspension and braking systems in an automobile.
4. To give information about motor vehicle emission and noise pollution control.
5. To provide knowledge of the vehicle telematics.
6. To give information about the noise control techniques.

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

1. Distinguish and describe the various modern vehicle power plant systems.
2. List and explain the various driver assistant mechanisms.
3. Identify and describe the working of advanced suspension and braking systems.
4. Apply the knowledge of motor vehicle emission and noise pollution control.
5. Describe the noise control techniques
6. Describe the vehicle telematics and its applications

UNITI TRENDS IN POWERPLANTS

Hybrid vehicles – stratified charged / learn burn engines – hydrogen engines – battery vehicles – electric propulsion with cables – magnetic track vehicles.

UNITII DRIVER ASSISTANCE SYSTEMS

Adaptive cruise control – intelligent speed adaptation – lane departure warning systems – traction control systems – driver drowsiness detection system – collision avoidance systems – hill descent control – anti spin regulation – parking assistance systems – night-vision systems – pedestrian detection.

UNITIII SUSPENSION, BRAKES ANDSAFETY

Interconnected air and liquid suspensions – hydrolastic suspension system – hydragas suspension – closed loop suspension – indirect floating calliper disc brake – self energising disc brake – anti-skid braking system – retarders – regenerative braking – auto emergency braking – crumple zone – safety cage – airbags – seat belts – headrests.

UNITIV EMISSION AND NOISE POLLUTIONCONTROL

Engine emissions – types of catalytic converters – open loop and closed loop operation to the oxidizing catalytic converter – evaporative emission – internal and external noise – identification of noise sources – noise control techniques – adaptive noisecontrol.

UNITV VEHICLETELEMATICS

Building blocks of vehicle telematics system – Global Positioning System (GPS) and Geographic Information System (GIS) for vehicle tracking – automotive navigation system – road recognition system – wireless vehicle safety communications – Usage Based Insurance (UBI).

SUGGESTED READINGS:

1. LjuboVlacic, Michael Parent and Fumio Harashima, *Intelligent Vehicle Technologies*, Butterworth-Heinemann, UK,2001.
2. Ronald K Jurgen, *Navigation and Intelligent Transportation Systems*, SAE International, USA,1998.
3. Heinz Heisler, *Advanced Vehicle Technology*, Butterworth-Heinemann, UK,2002.
4. James E Duffy, *Modern Automotive Technology*, Goodheart-Willcox, USA,2017.
5. William B Ribbens, *Understanding Automotive Electronics*, Butterworth-Heinemann, UK,2017.
6. *Bosch Automotive Handbook*, Robert Bosch, Germany, 2018.

18BEAEOE05 **FLEETMANAGEMENT** **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To impart knowledge on the personnel management, selection process, training methods and motor vehicle act.
2. To plan the vehicle routes, scheduling of vehicles and fare structure.
3. To design the vehicle maintenance systems.
4. To Study and acquire knowledge on fare structure and analyse the methods of fare collection
5. To introduce the concepts of vehicle parts, supply management and data processing
6. To Study and acquire knowledge on electronically controlled vehicle maintenance system

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

1. Apply the knowledge of personnel management and analyse the selection process and training methods.
2. Apply the motor vehicle act in terms of registration and describe the various vehicles and conduct the test of competence to drive.
3. Construct a fare structure and analyse the methods of fare collection.
4. Analyse the vehicle parts, supply management and data processing.
5. Describe the scheduled and unscheduled maintenance
6. Demonstrate an electronically controlled vehicle maintenance system and analyse the work schedule.

UNIT I INTRODUCTION

Personnel management – objectives and functions of personnel management – psychology, sociology and their relevance to an organization – selection process: job description, employment tests, interviewing, introduction to training objectives, methods of training, training procedure and psychological tests.

UNIT IIMOTOR VEHICLE ACT

Schedules and sections of the motor vehicle act – traffic signs, fitness certificate, registration requirements, permit, insurance and constructional regulations – description of vehicle: goods carrier, tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles – spread over, running time, test of competence to drive.

UNIT III SCHEDULING AND FARESTRUCTURE

Route planning – scheduling of transport vehicles – preparation of timetable – preparation of vehicle and crew schedule – principal features of operating costs for transport vehicles – fare structure and method of drawing up of a fare table – methods of farecollection.

UNITIV VEHICLE PARTS, SUPPLY MANAGEMENT ANDBUDGET

Cost of inventory – balancing inventory cost against downtime – parts control – bin tag systems – time management – time record keeping – budget activity and capital expenditures – classification of vehicle expenses – fleet management and data processing – data processing systems – computer controlling of fleet activity.

UNIT V MAINTENANCE

Scheduled and unscheduled maintenance – preventive maintenance – evaluation of Preventive Maintenance Inspection (PMI) programme – work scheduling – overtime – breakdown analysis – control of repair backlogs – cost of options – electronically controlled vehicle maintenancesystem.

SUGGESTED READINGS:

1. Robert P Currie, Michelle B Currie and George M Keen, *Fleet Management*, Wandering Brothers Publishing, USA,2006.
2. John Dolce, *Fleet Management*, McGraw-Hill,1984.
3. SCC Editorial, *Motor Vehicles Act, 1988*, Eastern Book Company, New Delhi,2019.
4. Rex W Faulks, *Bus and Coach Operation*, Butterworth-Heinemann, UK,1987.
5. John E Dolce, *Analytical Fleet Maintenance Management*, SAE International, USA,2009.

CIVIL ENGINEERING

18BECEOE01 HOUSING, PLANANDMANAGEMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To examine the role and tasks of basic housing policies and building bye laws
2. Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
3. Analyze the Innovative construction methods and Materials
4. Analyze city management strategies and strengthen the urban governance through a problem solving approach
5. To know the Importance of basic housing policies and building bye laws
6. To use Housing Programmes and Schemes

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNIT I INTRODUCTION TOHOUSING

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNITII HOUSINGPROGRAMMES

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

UNITIII PLANNING AND DESIGN OF HOUSINGPROJECTS

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNITIV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVEMATERIALS

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNITV HOUSING FINANCE AND PROJECTAPPRAISAL

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

SUGGESTED READINGS

1. Meera Mehta and Dinesh Mehta**,** Metropolitan Housing Markets**,** Sage Publications Pvt. Ltd., New Delhi**,** 2002
2. Francis Cherunilam and Odeyar D Heggade**,** Housing in India**,** Himalaya Publishing House, Bombay**,**2001
3. CMA**,** Development Control Rules for Chennai Metropolitan Area**,** CMA, Chennai**,**2002
4. UNCHS**,** National Experiences with Shelter Delivery for the Poorest Groups**,** UNCHS (Habitat), Nairobi**,** 2000

18BECEOE02 BUILDINGSERVICES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Defining and identifying of eng. services systems in buildings.
2. The role of eng. services systems in providing comfort and facilitating life of users of the building.
3. The basic principles of asset management in a building & facilities maintenance environment
4. Importance of Fire safety and its installation techniques
5. To Know the principle of Refrigeration and application
6. To Understand Electrical system and its selection criteria

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

UNITI MACHINERIES

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNITII ELECTRICAL SYSTEMS INBUILDINGS

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNITIII PRINCIPLES OF ILLUMINATION &DESIGN

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilisation factor – Depreciation factor – MSCP – MHCP – Lans of illumination – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in buildingtypes.

UNITIV REFRIGERATION PRINCIPLES &APPLICATIONS

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Subcooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNITV FIRE SAFETYINSTALLATION

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

SUGGESTED READINGS

1. E.R.Ambrose**,** Heat Pumps and Electric Heating**,** John and Wiley and Sons, Inc., New York**,**2002
2. NBC**,** Handbook for Building Engineers in Metric systems**,** NBC, New Delhi**,**2005
3. Philips Lighting in Architectural Design**,** McGraw-Hill, New York**,**2000
4. A.F.C. Sherratt, Air-conditioning and Energy Conservation, The Architectural Press, London,2005
5. National BuildingCode

18BECEOE03 REPAIR AND REHABILITATIONOFSTRUCTURES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To learn various distress and damages to concrete and masonry structures
2. To know the influence of corrosion in durability of structures
3. To understand the importance of maintenance of structures
4. To study the various types and properties of repair materials
5. To learn various techniques involved in demolition of structures
6. To Assessing damage of structures and various repair techniques

COURSE OUTCOMES

By the end of this course students will have the capability/knowledge of

1. Various distress and damages to concrete and masonry structures
2. Durability of structures and corrosion mechanism
3. The importance of maintenance of structures, types and properties of repair materials etc
4. Assessing damage of structures and various repair techniques
5. Modern technique and equipment being adopted for the demolition of structures
6. Influence of corrosion in durability of structures

UNITI INTRODUCTION

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

UNITII DURABILITY OFSTRUCTURES

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNITIII MAINTENANCE AND REPAIRSTRATEGIES

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNITIV MATERIALS FORREPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete. Eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

UNITV TECHNIQUES FOR REPAIR AND REPAIR OFSTRUCTURES

Non-destructive Testing Techniques, Corrosion protection techniques, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies

SUGGESTED READINGS

1. R.T.Allen and S.C.Edwards, Repair of Concrete Structures, Blakie and Sons, UK,2011

2. Dr.B.Vidivelli, Rehabilitation of concrete structures, Standard publishers,Chennai.2011

18BECEOE04 COMPUTER-AIDED CIVILENGINEERINGDRAWING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings
5. to produce designs using a combination of 2D and 3D software.
6. Get a Detailed study of an engineering artifact.

COURSE OUTCOMES

The students will be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

UNITI INTRODUCTION

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNITII SYMBOLS AND SIGNCONVENTIONS

Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

UNITIII MASONRYBONDS

English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

UNITIV BUILDINGDRAWING

Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

UNITV PICTORIALVIEW

Principles of isometrics and perspective drawing. Perspective view of building.

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors andwindows.
2. Single storey RCCbuilding
3. Multistorey RCCbuilding

SUGGESTED READINGS

1. Subhash C Sharma &Gurucharan Singh (2005), " Civil Engineering Drawing" , StandardPublishers
2. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- McGraw-Hill Company Limited, NewDelhi
3. Sham Tickoo Swapna D (2009), " AUTOCAD for Engineers and Designers" , PearsonEducation,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt.Ltd.,
5. Balagopal and Prabhu (1987), " Building Drawing and Detailing", Spades publishing KDR building, Calicut

CHEMICAL ENGINEERING

18BTCEOE01 ENERGY MANAGEMENT INCHEMICALINDUSTRIES 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To understand the need for energy.
2. To understand the correlation between energy and environment.
3. To understand about the evolution, growth and change in energy.
4. To understand energy management in industries.
5. To understand energy cost analysis.
6. To analyze energy conservation using optimization technique

COURSE OUTCOMES

After completion of the course, students are able to

1. Plan to optimize energy using systems and procedures to meet energydemand
2. Describe the movement of substances in the entireglobe
3. Examine the relationship between energy systems andsociety
4. Use optimization techniques for conservation of energy in chemicalindustries
5. Evaluate the production rate and analyze the cost from economic balance for energyconsumption.
6. Understand the components involved in energy auditing.

UNITI PLANNING FOR ENERGYNEEDS

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix ofenergy sources.

UNITII ENERGY AND ENVIRONMENT

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environmentpopulation and technology.

UNITIII ENERGY AND SOCIETY

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generationof power requirements and benefit.

UNITIV MANAGEMENT OF ENERGY CONSERVATION IN CHEMICALINDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation appliedto refineries, petrochemical, fertilizers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimizationtechniques.

UNITV ECONOMIC BALANCE IN ENERGYCONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and productionusing fuel inventories; input-output analysis; economics; tariffs

SUGGESTED READINGS

1. Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc,1976.
2. Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork,1975
3. Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc.,1976.
4. Gramlay G. M., Energy, Macmillan Publishing Co., New York,1975.
5. Rused C. K., Elements of Energy Conservation, McGraw-Hill Book Co.,1985

18BTCEOE02 FERTILIZERTECHNOLOGY 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To study biofertilizers supplement the requirements.
2. To study use of biofertilizers along with chemical fertilizers and organic manures.
3. To study fertilizer transport, application and maintaining field conditions.
4. To develop integrated nitrogenous and phosphatic biofertilizers.
5. To Accelerate biochemical processes.
6. To study nutrients available to the crops by the sue of fertilizers.

COURSE OUTCOMES

After completion of the course, students are able to

1. Illustrate chemical, organic fertilizers andnutrients
2. Develop the flow chart for manufacture of nitrogenousfertilizers
3. Analyze the various processes and develop the flow chart for the manufacture of phosphaticfertilizers.
4. Develop the flow chart for the manufacture of potassic fertilizer and analyze the unit operationsinvolved in theprocess.
5. Illustrate the quality and pollution standards permissible in fertilizerindustry.
6. Ability to distinguish the types of biofertilizers.

UNITI INTRODUCTION

Chemical Fertilizers and Organic Manures - Types of chemical Fertilizers.Secondary nutrients, micro nutrients.

UNITII NITROGENFERTILIZERS

Nitrogenous Fertilizers - Methods of production of Ammonia and Urea. Nitric acid, Ammonium sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride - Their methods of production, characteristics, storage and handling specifications.

UNITIII PHOSPHATICFERTILIZERS

Raw materials, phosphate rock, Sulphur pyrites -Process for the production of Sulphuric and Phosphoric acids. Ground phosphate rock, bone meal. Single Super Phosphate, Triple Super phosphate -Methods of production, characteristics and specifications.

UNITIV POTASSICFERTILIZERS

Potassium chloride, Potassium sulphate, Potassium schoenite - Methods of production, specification, characteristics. Complex Fertilizers, NPK Fertilizers, Mono ammonium phosphate, Diammonium phosphate, Nitro phosphate Methods of production.

UNITV FERTILIZERS IMPACTS ANDSTANDARDS

Fluid fertilizers.Controlled Release of fertilizers. Solid, Liquid and Gaseous pollution from ammonia urea and NPK fertilizer industries and standards laid down for them. Fertilizer production in India.

SUGGESTED READINGS

1. GopalaRao M., Marshall Sittig, Dryden's Outlines of Chemical Technology, Third Edition, WEP East-West Press, New Delhi,2010.
2. George T. Austin., Shreve's Chemical Process Industries, Fifth Edition, McGraw Hill Professional,2012
3. Vincent Sauchelli., The Chemistry and Technology of Fertilizers, Reinhold Pub. Corp.,1960
4. Editorial Committee - FAI Seminar on Fertilizer in India in the Seventies (Proceedings), TheFertilizer Association of India,New Delhi,1973.
5. Editorial Committee - Seminar on Recent Advances in Fertilizer Technology, The Fertilizer Association of India, NewDelhi,1972.
6. Sauchelli V., Manual on Fertilizer Manufacture, Industry Publication Inc, New Jersy,1963.
7. CHEMTECH - II - (Chapter on Fertilizers by Chari, K.S.), Chemical Engineering EducationDevelopment Centre, I.I.T.,Madras,1977.
8. Menon M.G., Fertilizer Industry - Introductory Survey, Higginbothams, Madras,1973

18BTCEOE03 INDUSTRIALWASTEWATERTREATMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Recognize the properties of the basic industries and the environmental impact of waste generated is able to compare.
2. Define the characteristics of industrial wastewater.
3. Establish a relationship between the properties of industrial wastewater.
4. Explain the principles of industrial wastewater refining.
5. Determine the appropriate treatment methods for textile industry wastewater.
6. Allow the properties of textile industry waste waters

COURSE OUTCOMES

After completion of the course, students are able to

1. Examine the constituents of waste water and itseffects.
2. Separate the contaminants from the effluent fortreatability.
3. Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludgeprocess.
4. Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceuticalindustries.
5. Develop process flow diagram for water reuse and sludgedisposal.
6. Students will learn treatment of industrial waste water.

UNITI INTRODUCTION TO WASTE WATERENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

UNITII OPERATIONS AND UNITPROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

UNITIII FUNDAMENTALS OF BIOLOGICALTREATMENT

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment -aerobic and anaerobic oxidation,Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons.

UNITIV WASTE WATER TREATMENT IN SPECIFICINDUSTRIES

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries.

UNITV WATERREUSE

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening,degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

SUGGESTED READINGS

1. Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, Tata McGraw Hill, New Delhi,2002.
2. Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall of India Pvt Limited, New Delhi,2012.
3. James M. Montgomery, Water Treatment Principles and Design, First Edition, A WileyInterscience publication, NewYork,1985.

18BTCEOE04 SOLID AND HAZARDOUSWASTEMANAGEMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Identify key sources, typical quantitiesgenerated, composition, and properties of solid and hazardous waste.
2. Identify waste disposal or transformation techniques
3. Recognize the relevant regulations that apply for facilities used for disposal, and destruction of waste.
4. Conduct invasive and non-invasive site investigation and apply permitting process for constructing landfills.
5. Estimate typical waste disposal costs
6. Identify recycling and reuse options

COURSE OUTCOMES

After completion of the course, students are able to

1. Outline the salient features of solid waste management andhandling.
2. Deduce the source reduction, recycling and reuse techniques of solidwaste.
3. Analyze the collection systems and method of transfer of solidwaste.
4. Describe the processing techniques for solid and hazardouswaste.
5. Select the suitable methods for disposal of solid and hazardouswaste.
6. Interpret the legislation for management, handling and disposal of solid and hazardouswaste.

UNITI CHARACTERISTICS AND SOURCE REDUCTION OF SOLIDWASTE

Definition, sources, and types of solid waste - Composition, physical, chemical and biological properties of solid wastes - Percapita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange - Recyclingand reuses - Salient features of Indian legislations on management and handling of municipal solid wastes.

UNITII COLLECTION AND TRANSPORT OF SOLIDWASTE

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services:municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary containersystem (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport - Transfer stationlocation- Means and methods of transfer.

UNITIII PROCESSING AND DISPOSAL OF SOLIDWASTE

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversiontechnologies- disposal in Landfills: site selection methods and operations, leachate and gas generations and movement andcontrol of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes.

UNITIV HAZARDOUS WASTE CHARACTERIZATION ANDMANAGEMENT

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardouswastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design ofhazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management – AtomicEnergy Regulatory Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation-
Nuclear power plants in India.

UNITV NUCLEAR WASTE ANDe-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear waste vitrification, ion exchange, synroc – long term management - above ground disposal, geological disposal, ocean dumping, transmutation, space disposal - reuse ofwaste - nuclear safety and waste regulation - case study on nuclear disaster - source of e-waste - material composition ofe-waste - recycling and recovery - integrated approaches to e-waste recycling - socio economic factors - treatment option -disposal option - e-waste legislation.

SUGGESTED READINGS

1. Tchobanoglous, G. et al., "Integrated Solid Waste Management", McGraw-Hill Publication., New York, 1993.
2. Ronald E. Hester, Roy M. Harrison "Electronic Waste Management", Royal Society of Chemistry,2009.
3. Peavy, SH, Rowe, RD and Tchobanoglous, G, "Environmental Engineering", McGraw-Hill Inter Edition, 1985.
4. Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publication,2002

FOOD TECHNOLOGY

18BTFTOE01 PROCESSING OFFOODMATERIALS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oilseeds
2. Summarize the production and processing methods of fruits andvegetables
3. Discuss the chemical composition, processing, production, spoilage and quality of milk and milkproducts
4. Outline the overall processes involved in the production of meat, poultry and fishproducts
5. Review the production and processing methods of plantation and spiceproducts
6. To learn food preservation tools.

COURSE OUTCOMES

1. Discuss the various processing technologies involved in cereal, pulses and oilseedtechnology
2. Demonstrate the major operations applied in fruits and vegetableprocessing
3. Illustrate the techniques involved in the processing of dairyproducts
4. Infer the production of different types ofmilk
5. List the overall processing of meat, poultry and fishprocessing
6. Outline the processing of spices and plantationproducts

UNIT I - CEREAL, PULSES AND OIL SEEDS TECHNOLOGY

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

UNIT II - FRUITS AND VEGETABLE PROCESSING

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

UNIT III - DAIRY PROCESSING

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products - Icecream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage ofmilk.

UNIT IV - MEAT, POULTRY AND FISH PROCESSING

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing.

UNIT V - PLANTATION PRODUCT TECHNOLOGY

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric.

SUGGESTED READINGS

1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition.2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition.2003.
3. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression.2016.

18BTFTOE02 NUTRITIONANDDIETETICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Explain the basic concepts of food andnutrition
2. Define the overall classification, function, and source of carbohydrates, lipids andproteins
3. Discuss the overall aspects ofvitamins
4. Outline the role of health and nutritional importance of micro and macrominerals
5. Summarize the recent trends in nutrition
6. To understand the importance of nutrition for good health.

COURSE OUTCOMES

1. Discuss the basics in the area of nutritional assessment in health anddisease
2. Categorize the recommended dietary allowances for different agegroups
3. Express the classifications, functions and sources of carbohydrates, lipids andproteins
4. List the various attributes of fat and water solublevitamins
5. Report the role, bioavailability, sources and deficiency diseases of macro and microminerals
6. Recognize the diets and concepts of foods suggested for nutrional, chronic and acutedisorders

UNIT I - HUMANNUTRITION

Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health andwellbeing.

UNIT II - BIOMOLECULES

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III - VITAMINS

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

UNIT IV - MINERALS

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum andfluoride.

UNIT V - RECENT TRENDS IN NUTRITION

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

SUGGESTED READINGS

1. Gordon M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition.2013.
2. Shubhangini A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition.2016.
3. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition.2017.
4. Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell. 2003.
5. SunetraRoday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018.

18BTFTOE03 READY TOEATFOODS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Outline the current status of snack foodIndustry
2. Describe the production, processing and marketing trends of potato and tortillachips
3. Outline the overall processing ofpopcorn
4. Explain the production and processing of fruits involved in snack foodpreparation
5. Summarize the sensory analysis methods and packaging techniques of snackfoods
6. To understand food preservation techniques.

COURSE OUTCOMES

1. Review the overall aspects of snack foodindustry
2. Develop ready to eat foods from potato and maizeflour
3. Demonstrate the various unit operations involved in the production of potato and tortillachips
4. Illustrate the overall aspects of popcornproduction
5. List the production, processing and manufacturing of fruit basedsnacks
6. Recognize the sensory analysis and packaging methods of snackfoods

UNIT I SNACK FOOD INDUSTRY

Introduction-History-Past innovations- Outline of snack food industry- Nutrition-Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association Future Considerations

UNIT II POTATO AND TORTILLA CHIPS PROCESSING

Potato Production- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Other value added products from Potato.

Tortilla chips - Raw Materials- Processing steps-Equipment involved-Reconstitution of Dry Maize Flour-Unit operations.

UNIT III POPCORN PROCESSING

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn

Packaging- Relative Nutrition- Marketing.

UNIT IV FRUIT BASED SNACKS

Introduction-production and processing of fruit crops – fruit purees – fruit powders – canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars – exotic fruits.

UNIT V SENSORY EVALUATION AND PACKAGING

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing-Current Issues in Snack FoodsPackaging

SUGGESTED READING

1. Lusas, E. W and Rooney, L. W. Snack Foods Processing. CRC Press,1st Edition2001.
2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2nd Edition2013.
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd.2008.

18BTFTOE04 AGRICULTURAL WASTE ANDBYPRODUCTS UTILIZATION **3 H – 3 C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. Categorize the types of agriculturalwastes
2. Outline the production and utilization ofbiomass
3. Explain the various parameters considered to be important in the designing of biogasunits
4. Review the various methods employed in the production of alcohol from the byproducts of agricultural wastes
5. Summarize the overall aspects involved in the production of paperboards and particleboards from agriculturalwastes
6. To learn about various waste to energy conversion technologies.

COURSE OUTCOMES

1. List and group the types of agriculturalwastes
2. Develop a number of value added products from agriculturewastes
3. Discuss the techniques and production involved in the utilization ofbiomass
4. Assess the various parameters considered to be important in the designing of biogasunits
5. Illustrate thevarious methods employed in the production of alcohol from the byproducts of agricultural wastes
6. Choose the appropriate materials to produce paperboards and particle boards from agriculturalwastes

UNIT 1-TYPES OF AGRICULTURAL WASTES

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculturewaste/by-products.

UNIT 2-BIOMASS PRODUCTION AND UTILIZATION

Biomass Gasifier, Technology used for the utilization of agricultural wastes: Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI) Gasifier, Rice-Husk Based Gasifier, Heat and Steam from Sugarcane Leaf and Bagasse.

UNIT 3-BIOGAS DESIGN AND PRODUCTION

Biogas: Definition, composition, history of biogas, Production of biogas; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogasplant.

UNIT 4-PRODUCTION OF ALCOHOL FROM WASTE MATERIALS

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

UNIT 5-PRODUCTION OF PAPERBOARDS AND PARTICLEBOARDS FROM AGRICULTURAL WASTE

Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

SUGGESTED READINGS

1. K M Sahay and K K Singh. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt Ltd, Noida, Uttar Pradesh. 2nd Edition2013.
2. Beggs C. Energy Management and Conservation. Elsevier Pulication. 2nd Edition2009.
3. Chaturvedi P. 2009. Energy Management: Challenges for the Next Millennium. Concept Publishing Co. 1st Edition2000.
4. Fardo SW, Patrick DR, Richardson RE and Fardo BW. Energy Conservation Guidebook. The Fairmont Press. 3rd Edition2014.
5. Wulfinghoff DR. Energy Efficiency Manual. Energy Institute Press.2000.

COURSES OFFERED TO OTHER DEPARTMENTS

18BEMEOE01 COMPUTERAIDEDDESIGN 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To apply basic concepts to develop construction (drawing) techniques.
2. To ability to manipulate drawings through editing and plotting techniques.
3. To understand geometric construction and Produce template drawings.
4. To understand and demonstrate dimensioning concepts and techniques.
5. To understand Section and Auxiliary Views.
6. To become familiar with Solid Modelling concepts and techniques.

COURSE OUTCOMES

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

1. Apply basic concepts to develop construction (drawing) techniques.
2. Ability to manipulate drawings through editing and plotting techniques.
3. Understand geometric construction and Produce template drawings.
4. Understand and demonstrate dimensioning concepts and techniques
5. Understand Section and Auxiliary Views
6. Become familiar with Solid Modelling concepts and techniques.

UNITI OVERVIEW OF CAD SYSTEMS

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNITII INTERACTIVE COMPUTER GRAPHICS AND GRAPHICSTRANSFORMATIONS

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

UNITIII GEOMETRIC MODELING

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, Boolean operations. Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry(CSG) and Analytical Solid Modeling(ASM)

UNITIV PARAMETRIC DESIGN AND OBJECTREPRESENTATION

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations.

UNITV PRODUCT DESIGN ANDDEVELOPMENT

Automated 2D drafting - basics, mechanical assembly - bill of materials generation. Mass property calculations.

SUGGESTED READINGS

1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers,1st edition, John Wiley & Sons, New York,2000
2. Radhakrishnan P and Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd,2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice,2nd edition,McGraw Hill Inc., New York,2009
4. Barry Hawhes, The CAD/CAM Process,1st edition, Pitman Publishing, London,2007(digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics,1st edition,McGraw Hill Inc., New York,2001
6. Sadhu Singh, Computer-Aided Design and Manufacturing,1st edition, Khanna Publishers, New Delhi,1998
7. Rao S S, Optimization Techniques, 1st edition,Wiley Eastern, New Delhi,2006

18BEMEOE02 INDUSTRIAL SAFETYANDENVIRONMENT 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To recognize and evaluate occupational safety and health hazards in the workplace.
2. To determine appropriate hazard controls following the hierarchy of controls.
3. To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. To teach student the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. To prevent or mitigate harm or damage to people, property, or the environment.

COURSE OUTCOMES

At the end of the course, student will be able to

1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. Prevent or mitigate harm or damage to people, property, or the environment.

UNITI CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNITII TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNITIII ACCIDENT INVESTIGATION ANDREPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNITIV SAFETY PERFORMANCEMONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

UNITV SAFETY EDUCATION ANDTRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago,2010(digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill Company, New York, 1941.
3. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay,1997.
4. John R Ridley, Safety at Work,3rd edition,Elsevier,2014
5. Roland P. Blake ,Industrial Safety, 2nd edition,Prentice Hall, Inc., New Jersey,1973
6. L M Deshmukh, Industrial safety management,1st edition, TATA McGraw Hill,2005

18BEMEOE03 TRANSPORTPHENOMENA 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To generalized equations for mass, momentum and heat.
2. To understand the concepts of Reynolds and Gauss theorems.
3. To learn combined diffusive and convective transport.
4. To apply Film- and penetration models for mass and heat transfer.
5. To apply Stefan-Maxwells equations for multi-component diffusion.
6. To Solve the given set of equations either analytically or numerically.

COURSE OUTCOMES

1. Generalized equations for mass, momentum and heat.
2. Understand the concepts of Reynolds and Gauss theorems.
3. Learn combined diffusive and convective transport.
4. Apply Film- and penetration models for mass and heat transfer.
5. Apply Stefan-Maxwells equations for multi-component diffusion.
6. Solve the given set of equations either analytically or numerically.

UNITI INTRODUCTION AND BASICCONCEPTS

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

UNITII PROPERTIES, UNITS AND OTHER PHYSICALPARAMETERS

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

UNITIII MOMENTUM TRANSPORT

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed

UNITIV ENERGYTRANSPORT

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heattransfer

UNITV MASS TRANSPORT

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion-Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping

SUGGESTED READINGS

1. Geankoplis, C. J, Transport Processes and Separation Processes Principles, 4th edition,Prentice Hall,2013
2. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, 1st edition, John Wiley& Sons, 2007.
3. Edwin N. Lightfoot, Transport phenomena and living systems: biomedical aspects of momentum andmass transport, 1st edition, Wiley, 1973, 2007(digital)

18BEMEOE04 INTRODUCTIONTOBIOMECHANICS 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

COURSE OBJECTIVES

1. To describe the principles of the study of human movement.
2. To describe the range of factors that influence the initiation, production and control of human movement.
3. To identify the body's lever systems and their relationship to basic joint movement and classification.
4. To distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
5. To explain joint and muscle function and the forces acting upon the human body during various sporting activities.
6. To relate the different body systems necessary for human movement to occur.

COURSE OUTCOMES

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UNITI INTRODUCTION

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

UNITII KEY MECHANICALCONCEPTS

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

UNITIII HUMAN ANATOMY AND SOME BASICTERMINOLOGY

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - Anthropometric Data

UNITIV ANATOMICALDESCRIPTION

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

UNITV MECHANICS OF THE MUSCULOSKELETALSYSTEM

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

SUGGESTED READINGS

1. Duane Knudson, Fundamentals of Biomechanics, 1st edition,Springer Science+ Business Media, LLC,2013
2. C. Ross Ethier Craig A. Simmons, Introductory Biomechanics,1st edition,Cambridge University Press, 2008