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Dist. - Rayagada, Odisha, INDIA www.giet.edu

CURRICULUM, SYLLABUS AND COURSE STRUCTURE

FOR

UNDER GRADUATE DEGREE PROGRAMME

IN

ENGINEERING & TECHNOLOGY

REGULATION 2017

MECHANICAL ENGINEERING

REGULATIONS– 2017

SUMMARY

SL. No	SUBJECT AREA		CREDIT AS PER SEMESTER								CREDIT TOTAL
			1	II	III	IV	V	VI	VII	VIII	
1.	HS	Humanities and Social Sciences	4	4	3	3		4			**18**
2.	BS	Basic Sciences	8	8	4		3				**23**
3.	ES	Engineering Sciences	12	12	4	4					**32**
4.	PC	Professional Core			13	17	19	10	9	10	**78**
5.	PE	Professional Elective						6	11	6	**23**
6.	OE	Open Elective					3	3	3	3	**12**
7.	EEC	Employment Enhancement Courses									

TOTAL			**24**	**24**	**24**	**24**	**25**	**23**	**23**	**19**	**186**
8.	Non Credit/ Mandatory										0

VISION

- To develop globally competent Mechanical Engineers with innovation and research culture leading to entrepreneurship and successful in advanced fields of Engineering and Technology towards a societal change.

MISSION

- To impart quality education to the students and enhance their skills to make them successful Mechanical Engineers.
- To maintain vital (state–of–the-art) facilities to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- To develop linkages with reputed R&D organizations and educational institutions in India for excellence in teaching, research and consultancy practices.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO1:Graduates of the program will have a successful career of mechanical engineering by imparting Mechanical Engineering concepts and practical knowledge.
- PEO2:Graduates of the program will pursue higher education and research in the field of mechanical engineering.
- PEO3:Graduates of the program will exhibit Scientific and Engineering expertise and perform as a Professional Entrepreneur.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO 1: Ability to apply the acquired Mechanical Engineering knowledge for the development of composite materials for societal application.
- PSO 2: Ability to apply the acquired Mechanical Engineering knowledge for the development of automobile systems.

PROGRAMME OUTCOMES (POs)

PO-1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO- 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO- 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO- 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO- 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO- 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO- 9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO- 12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

I SEMESTER

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1.	BS	BBSBS1010	Engineering Mathematics-I	3	1	0	4	A
2.	BS	BBSBS1021	Engineering Physics	3	0	0	3	A
		BBSBS1022	Engineering Chemistry					
3.	ES	BBSES1031	Basics of Mechanics	3	0	0	3	A
		BBSES1032	Basics of Thermodynamics					
4.	ES	BBSES1041	Basics of Electronics	3	0	0	3	A
		BBSES1042	Basics Electrical Engineering					
5.	ES	BBSES1050	Programming In 'C	3	0	0	3	A
6.	HS	BBSHS1060	Communicative English-I	2	0	0	2	A
PRACTICAL								
1.	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	
		BBSBS1122	Engineering Chemistry Laboratory					
2.	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	
		BBSES1142	Basics Electrical Engineering Laboratory					
3.	ES	BBSES1150	Programming in 'C' Laboratory	0	0	2	1	
4.	HS	BBSHS1160	Communicative English-I Laboratory	0	0	2	1	
5.	ES	BBSES1171	Engineering Drawing	0	0	2	1	
		BBSES1172	Engineering Workshop					
6.	HS	BBSHS1180	NSS / NCC	0	0	2	1	
TOTAL				**17**	**1**	**12**	**24**	

2ND SEMESTER

SL.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1.	BS	BBSBS2010	Engineering Mathematics-II	3	1	0	4	A
2.	BS	BBSBS1021	Engineering Physics	3	0	0	3	A
		BBSBS1022	Engineering Chemistry					
3.	ES	BBSES1031	Basics of Mechanics	3	0	0	3	A
		BBSES1032	Basics of Thermodynamics					
4.	ES	BBSES1041	Basics of Electronics	3	0	0	3	A
		BBSES1042	Basics Electrical Engineering					
5.	ES	BBSES2050	Data Structure	3	0	0	3	A
6.	HS	BBSHS2060	Communicative English-II	2	0	0	2	A
PRACTICAL								
1.	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	
		BBSBS1122	Engineering Chemistry Laboratory					
2.	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	
		BBSES1142	Basics Electrical Engineering Lab					
3.	ES	BBSES2150	Data Structure Using C++ Laboratory	0	0	2	1	
4.	HS	BBSHS2160	Communicative English-II Laboratory		0	2	1	
5.	ES	BBSES1171	Engineering Drawing	0	0	2	1	
		BBSES1172	Engineering Workshop					
6.	HS	BBSHS2180	YOGA / Project Work	0	0	2	1	
TOTAL				**17**	**1**	**12**	**24**	

III SEMESTER [SECOND YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1.	BS	BBSBS3040	Engineering Mathematics – III	3	1	0	4	A
2.	PC	BMEPC3010	Mechanics of Solids	3	1	0	4	A
3.	PC	BMEPC3020	Fluid Mechanics & Hydraulics Machines	3	0	0	3	A
4.	PC	BMEPC3030	Introduction to Physical Metallurgy & Engineering Materials	3	0	0	3	A
5.	ES	BCSES3051	OOPS through JAVA	3	0	0	3	A
		BCSES3052	Database Management Systems					
6.	HS	BMGHS3061	Engineering Economics & costing	3	0	0	3	A
		BMGHS3062	Environmental Engineering & Safety					
PRACTICAL								
1.	PC	BMEPC3110	Mechanics of Solids Laboratory	0	0	2	1	
2.	PC	BMEPC3120	Fluid Mechanics & Hydraulics Machines Laboratory	0	0	2	1	
3.	PC	BMEPC3130	Introduction to Physical Metallurgy & Engg Materials Laboratory	0	0	2	1	
4.	ES	BCSES3151	JAVA Programming Laboratory	0	0	2	1	
		BCSES3152	Database Management Systems Laboratory					
TOTAL				**18**	**2**	**8**	**24**	

IV SEMESTER [SECOND YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1.	PC	BMEPC4010	Engineering Thermodynamics	3	0	0	3	A
2.	PC	BMEPC4020	Kinematics of Machinery	3	1	0	4	A
3.	PC	BMEPC4030	Basic Manufacturing Process	3	1	0	4	A
4.	PC	BMEPC4040	Mechanical Measurement & Metrology	3	0	0	3	A
5.	ES	BCSES3051	OOPS through JAVA	3	0	0	3	A
		BCSES3052	Database Management Systems					
6.	HS	BMSHS3061	Engineering Economics and Costing	3	0	0	3	A
		BBSBS3062	Environmental Engineering and Safety					
PRACTICAL								
1.	PC	BMEPC4110	Engineering Thermodynamics Laboratory	0	0	2	1	
2.	PC	BMEPC4120	Kinematics of Machinery Laboratory	0	0	2	1	
3.	PC	BMEPC4130	Basic Manufacturing Process Laboratory	0	0	2	1	
4.	ES	BCSES3151	JAVA Programming Lab	0	0	2	1	
		BCSES3152	Database Management Systems Laboratory					
TOTAL				**18**	**2**	**8**	**24**	

V SEMESTER [THIRD YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC5010	Internal Combustion Engines	3	1	0	4	A
2	PC	BMEPC5020	Machining Science & Technology	3	0	0	3	A
3	PC	BMEPC5030	Design of Machine Elements	3	0	0	3	A
4	PC	BMEPC5040	Dynamics of Machinery	3	0	0	3	A
5	OE	B**OE5051 B**OE5052 B**OE5053 B**OE5054	Open Elective-1 (Any one)	3	0	0	3	A
6	BS/ HS	BBSBS5061 BMSHS5062	Optimization in Engineering Organizational Behaviour	3	0	0	3	A
PRACTICAL / SESSIONAL								
7	PC	BMEPC5110	Internal Combustion Engines Laboratory	0	0	2	1	
8	PC	BMEPC5120	Machining Science & Technology Laboratory	0	0	2	1	
9	PC	BMEPC5130	Design of Machine Elements Laboratory	0	0	2	1	
10	PC	BMEPC5140	Dynamics of Machinery Laboratory	0	0	2	1	
11	PC	BMEPC5150	*Skill Development Project and Hands on Training	0	0	2	1	
12	PC	BMEPC5170	^Summer Internship-I	0	0	2	1	
		TOTAL:		**18**	**1**	**12**	**25**	

VI SEMESTER [THIRD YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC6010	Heat Transfer	3	1	0	4	A
2	PC	BMEPC6020	Design of Machine Components	3	0	0	3	A
3	PE	BMEPE6031	Advanced Mechanics of Solid	3	0	0	3	A
		BMEPE6032	Advanced Fluid mechanics					
		BMEPE6033	Automobile Engineering					
		BMEPE6034	Advanced Welding Technology					
4	PE	BMEPE6041	Mechatronics	3	0	0	3	A
		BMEPE6042	Refrigeration & Air Conditioning					
		BMEPE6043	Quality Control And Reliability					
		BMEPE6044	CAD / CAM					
5	OE	B**OE6051	Open Elective-II *(Any One)*	3	0	0	3	A
		B**OE6052						
		B**OE6053						
		B**OE6054						
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3	A
		BMSHS5062	Organizational Behaviour					
PRACTICAL / SESSIONAL								
7	PC	BMEPC6110	Heat Transfer Lab	0	0	2	1	
8	PC	BMEPC6120	Design of Machine Components Lab	0	0	2	1	
10	PC	BMEPC6140	Advanced Lab-I	0	0	2	1	
11	HS	BTPHS6160	#Soft Skill and Employability Skill	0	0	2	1	
		TOTAL:		**18**	**1**	**8**	**23**	

VII SEMESTER [FOURTH YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC7010	Industrial Engineering	3	0	0	3	A
2	PE	BMEPE7021	Finite Element Methods	3	0	0	3	G
		BMEPE7022	Advanced IC Engine					A
		BMEPE7023	Modern Manufacturing Processes					A
		BMEPE7024	Non-Destructive Evaluation & Testing					C
3	PE	BMEPE7031	Computational fluid Dynamics	3	0	0	3	A
		BMEPE7032	Additive Manufacturing					B
		BMEPE7033	Mechanical Vibration					G
		BMEPE7034	Tribology					F
4	PE	BMEPE7041	Design and Analysis of Heat Exchanger	3	0	0	3	A
		BMEPE7042	Fire and safety engineering					A
		BMEPE7043	Robotics and Robot application					G
		BMEPE7044	Nano Science					G
5	OE	B**OE7051	Open Elective-III*(Any One)*	3	0	0	3	A
		B**OE7052						
		B**OE7053						
		B**OE7054						
PRACTICAL / SESSIONAL								
6	PC	BMEPC7110	Industrial Engineering Laboratory	0	0	2	1	
7	PC	BMEPC7140	Advanced Laboratory -II	0	0	2	1	
8	PC	BMEPC7150	Mini Project / Projects on Internet of Things	0	0	6	3	
9	PE	BMEPE7160	## Massive Open Online Course (MOOC)	0	0	4	2	
10	PC	BMEPC7170	^Summer Internship-II	0	0	2	1	
		TOTAL:		**15**	**0**	**16**	**23**	

VIII SEMESTER [FOURTH YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PE	BMEPE8011	Power Plant Engineering	3	0	0	3	A
		BMEPE8012	Reverse Engineering					B
		BMEPE8013	Product design & product tooling					A
		BMEPE8014	Advanced computer graphics and solid Modelling					G
2	PE	BMEPE8021	Composite materials	3	0	0	3	G
		BMEPE8022	Computer Integrated manufacturing					C
		BMEPE8023	Cryogenics					A
		BMEPE8024	Gas Turbine & Jet Propulsion					A
3	OE	B**OE8031	Open Elective-IV *(Any One)*	3	0	0	3	A
		B**OE8032						
		B**OE8033						
		B**OE8034						
PRACTICAL / SESSIONAL								
4	PC	BMEPC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	12	6	
5	PC	BMEPC8180	Seminar and Technical Writing	0	0	4	2	
6	PC	BMEPC8190	Comprehensive Viva-Voce	0	0	4	2	
		TOTAL:		**9**	**0**	**20**	**19**	

UG in Mechanical Engineering

I SEMESTER

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
7.	BS	BBSBS1010	Engineering Mathematics-I	3	1	0	4	A
8.	BS	BBSBS1021	Engineering Physics	3	0	0	3	A
		BBSBS1022	Engineering Chemistry					
9.	ES	BBSES1031	Basics of Mechanics	3	0	0	3	A
		BBSES1032	Basics of Thermodynamics					
10.	ES	BBSES1041	Basics of Electronics	3	0	0	3	A
		BBSES1042	Basics Electrical Engineering					
11.	ES	BBSES1050	Programming In 'C	3	0	0	3	A
12.	HS	BBSHS1060	Communicative English-I	2	0	0	2	A
PRACTICAL								
7.	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	
		BBSBS1122	Engineering Chemistry Laboratory					
8.	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	
		BBSES1142	Basics Electrical Engineering Laboratory					
9.	ES	BBSES1150	Programming in 'C' Laboratory	0	0	2	1	
10.	HS	BBSHS1160	Communicative English-I Laboratory	0	0	2	1	
11.	ES	BBSES1171	Engineering Drawing	0	0	2	1	
		BBSES1172	Engineering Workshop					
12.	HS	BBSHS1180	NSS / NCC	0	0	2	1	
TOTAL				**17**	**1**	**12**	**24**	

I SEMESTER

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS 1010	**ENGINEERING MATHEMATICS-I**	**3**	**1**	**0**	**4**	**A**

Pre –Requisite: Fundamental of calculus

Course Educational Objectives

CEO1	To find critical points, and use them to locate maxima and minima.
CEO2	To provide the standard methods for solving differential equations.
CEO3	To study Fourier series and to express a function in Fourier series.
CEO4	To use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Implement the engineering problems using the concept of Partial differentiation and series and to understand its application.
CO2	Solve the initial value and boundary value problem of ODE related to Electrical circuit.
CO3	Execute the technique of Fourier series for applying in Engineering applications.
CO4	Find the Eigen value and vector of a matrix by using properties of linear algebra

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2												
CO2	2	3												
CO3	1	3												
CO4	2	3												
Avg.	1.5	2.75												

SYLLABUS

UNIT-I MULTI-VARIABLE CALCULUS (13 Hours)

Partial differentiation, Euler's theorem, Total derivative, Taylor's theorem for function of two variable (without proof), Maxima and Minima for function of two variables, Differentiation under integral sign (Leibnitz rule).

UNIT- II (12 Hours)

DIFFERENTIAL EQUATIONS-I

Ordinary differential Equations: First order and first degree differential equations and their method of solving, Application to Electrical circuits and heat conduction.

DIFFERENTIAL EQUATIONS-II

Linear differential equations of higher order and their different methods of solutions (operator methods). Second order linear differential equations and their solutions: Euler Cauchy equation, solution by undermined coefficient method and variation of parameters. Simple application to electrical circuits.

UNIT -III (10 Hours)

Fourier series, Fourier expansion of functions of arbitrary period, Even and odd functions, Half Range Expansion.

UNIT -IV LINEAR ALGEBRA: (15 Hours) Matrices, Types of matrices, Rank of matrix, Eigen values and Eigen vectors, Cayley – Hamilton theorem (without proof), system of linear equations, Orthogonal matrices, Complex matrices, Herrmitian and skew-Herrmitian matrices, Unitary matrices, similarity of matrices. Quadratic forms and Canonical forms.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey 2. Differential Calculus by Santi Narayan and Mittal, S.Chand Publications
Reference Books: 1. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi. 2. Higher Engineering Mathematics by B.V.Ramana, McGraw Hills Education 3. Advanced Engineer methods by N. P. Bali & Manish Goyal.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1021	ENGINEERING PHYSICS	3	0	0	3	A

Pre – Knowledge in +2 Physics and Mathematics

Course Educational Objectives

CEO1	Providing fundamental knowledge about the oscillations and waves
CEO2	To familiar with structure and properties of materials.
CEO3	Providing knowledge of mathematical concepts to solve electromagnetic problems and fundamental information about Quantum mechanics with applications.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand and analyze the concept of oscillation and wave mechanics.
CO2	Describe the principle of lasing and optoelectronics devices in communication system..
CO3	Explain the ideas of crystal structure, crystal diffraction and classification of materials.
CO4	Interpret the fundamentals of electromagnetism and deduce the electromagnetic wave equations.
CO5	Express the basics of quantum mechanics and illustrate the quantum mechanical problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3	2											
CO2					3		1							
CO3		3			1									
CO4	3		2											
Avg.	0.75	1.5	1		1		0.25							

SYLLABUS

UNIT: 01 (12 Hours)

Interaction of Wave and Matter

Simple Harmonic Oscillator, Damped harmonic oscillator and Forced harmonic oscillator, and coupled oscillator, Waves and its Characteristics, Superposition of Waves, Interference by division of wave front (Bi-prism experiment) and division of amplitude (Newton's Ring experiment). Introduction to Diffraction, types of diffraction.

LASER, spontaneous & stimulated emission, Einstein's relation, Ruby Laser and He-Ne Laser, Semiconductor laser, application of Laser. Optical fiber, Acceptance angle, Numerical aperture, Skip distance, Step index and Graded index fibers, Attenuations in optical fibers, applications of optical fiber in communication systems.

UNIT: 02 (12 Hours)

Physics of Materials

Introductions to materials, Crystallography, Crystal structure, crystal direction and plane, Miller indices, Inter planar spacings, Reciprocal Lattice and its characteristics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, Bragg's law. Energy bands in solids (conduction band, valence band and Fermi level), Classification of materials on the basis of band theory. Magnetic properties of Materials & their applications. Nano materials and applications (particulates, thin films, nano structures, etc.)

UNIT: 03 (10 Hour)

Electromagnetic theory and wave

Review of grad, divergence and curl, Gauss divergence theorem and Stoke's theorem (no derivations), fundamental laws of electrostatics, magneto-statics and electromagnetism, displacement current and conduction current, Maxwell's equations. Electromagnetic wave and its characteristics, electromagnetic wave equation for free space and in charge free conducting medium, electromagnetic energy, Poynting vector and Poynting theorem.

UNIT: 04 (12 Hours)

Quantum Mechanics

Introduction to dual nature: Black body radiation, photoelectric effect, Compton effect (qualitative idea only), de-Broglie's hypothesis, Heisenberg's uncertainty principle and its application to non-existence of electron inside the nucleus and ground state energy of one dimensional harmonic oscillator, Basic postulates of Quantum Mechanics, Wave function and its characteristics, probability density , normalization, eigen values, eigen functions and expectation values, Schrödinger's equation (time dependent and time independent). Application of Schrödinger equation to one dimensional potential well, potential step and potential barrier (qualitative ideas).

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Engineering Physics by D. K. Bhattacharya and Poonam Tanden, Oxford University Press.
2. Engineering Physics, H K Malik and A K Singh, Tata McGraw Hill, MGH.

Reference Books:

1. Materials Science & Engg., V. Raghvan, Prentice Hall of India.
2. Concepts of Modern Physics, A. Beiser, S. Mahajan, S.R. Choudhary, Tata McGraw Hill.
3. Lasers & Optical engineering, P Dass, Narosa Publishers, Springer Publisher.
4. Engineering Physics by B. B. Swain and P. K. Jena, Kitab Mahal,Cuttack
5. Quantum Mechanics by SatyaPrakash, Kitab Mohal, etc. Kedar Nath Ram Nath Publisher

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1022	**ENGINEERING CHEMISTRY**	**3**	**0**	**0**	**3**	**A**

Pre –Requisite: Chemistry

Course Educational Objectives

CEO1	To impart the knowledge of application of chemical sciences in the field of engineering
CEO2	To focus on microscopic chemistry in terms of atomic and molecular levels.
CEO3	The course aims at elucidating principles of applied chemistry in water treatment.
CEO4	To give detailed account about the reactivity of metals w.r.t prevention of corrosion.
CEO5	To enlighten the students with the applications of polymers.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Analyze microscopic chemistry in terms of atomic and molecular orbital and Explain the ranges of the electromagnetic spectrum by electronic transition
CO2	Identify water treatment techniques for domestic and industrial purposes
CO3	Compare types of corrosion, and it's control measures.
CO4	Understand various types of polymers, their preparation along with applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2		2	3							
CO2	3	3	1	2		2	3							
CO3	3	3	2	1		2	3							
CO4	3	3	2	1		2	3							
Avg.	3	2.75	1.75	1.5		2	3							

SYLLABUS

UNIT-1 ATOMIC AND MOLECULAR STRUCTURE (13 Hours)

Schrodinger's wave equation(no derivation), Significance of wave functions, Particle in a box, Application for conjugated molecule, Molecular Orbital theory and Energy level diagram for Diatomic molecules, Spectroscopic techniques and applications: Electronics spectroscopy, Vibrational and rotational spectroscopy of diatomic molecules.

UNIT-2 WATER CHEMISTRY (13 Hours)

Types of Hardness, Determination of Hardness by EDTA method, Treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Carbonate and phosphate conditioning, Colloidal conditioning, Calgon conditioning.

UNIT-3 CORROSION (10Hours)

Thermodynamic functions: Entropy, Free energy, Relation between E.M.F and free energy, The Nernst's equation and application, Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, Corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Inhibitors, Protective coatings: Galvanization and Tinning.

UNIT -4 POLYMER CHEMISTRY (12 Hours) Introduction, polymer, Classification of polymers, Plastics: Thermosetting and thermo plastic, PVC, PE, PS, PMMA, PTFE, Bakelite,Nylon-6,6,Nylon-6, Fiber reinforced plastic. *ADD-ON COURSES: Conducting Polymer (Polyaniline, Polyacetylene), Bio-Degradable and Non-Bio Degradable polymer, Nano composite.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1.Engineering chemistry by Jain & Jain, Dhanpat Rai publishing company (p) Ltd
Reference Books: 1. A Text Book of Engineering Chemistry by S.S.Dara, S Chand Publishers. 2. A Text Book of Engineering Chemistry by SashiChawla, Dhanpat Rai Publishing house. 3. Text Book of Engineering Chemistry, 2nd edition, by R.Gopalan, D.Venkapaya & Sulochana Nagarajan, Vikas Publishing House Pvt. Ltd. 4. B. Tech Chemistry- I and II by P. K. Kar, S. Dash, B. Mishra kalyani publishers. 5. Physical Chemistry By P.W Atkins 6. Engineering Chemistry(NPTEL Web Book) by B . L Tembe, Kamaluddin and M.S. Krishna 7. Fundamentals of Molecular spectroscopy By C . N Banwell 8. University chemistry by B.H. Mahan

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1031	**BASICS OF MECHANICS**	**3**	**0**	**0**	**3**	**A**

Pre –Requisite: Physics, Mathematics

Course Educational Objectives

CEO1	To apply the established engineering method to complex engineering problem.
CEO2	To understand the vectorial and scalar representation of forces and moments.
CEO3	To evaluate the different forces exhibit in truss member.
CEO4	To obtain the knowledge on kinematics and kinetics of particle to analyze simple and practical problems

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Determine the resultant force and moment for given force system.
CO2	Evaluate the forces in members of trusses, frames and problems related to friction.
CO3	Analyze the properties of surface in relation to centroid and moment of inertia
CO4	Adapt the laws of motion, kinematics of motion and their interrelationship

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	3												
CO3	3	3												
CO4	2	3												
Avg.	2.5	2.75												

SYLLABUS

UNIT:1 [16 Hours]

STATICS OF PARTICLES

Fundamental concepts and principles of engineering mechanics. Resolution of forces Resultant of several concurrent forces Free body diagram. Principles of transmissibility. Moment of a force Varignon's theorem Equivalent system of forces Types of supports and corresponding reactions.

UNIT:2 [12 Hours]

ANALYSIS OF TRUSSES AND FRICTION

Introduction to Truss Analysis of Trusses Method of joints, Method of sections.
Laws of Friction Angle of Friction Angle of Repose Ladder and Wedge Friction

UNIT:3 [12 Hours]

PROPERTIES OF SURFACES

Determination of first moment area of plane figures by integration – Determination of centroid of composite figures by using standard formula.
Determination of second moment area of plane figures by integration Parallel and perpendicular axis theorems Determination of area moment of inertia of composite

figures by using standard formula Polar moment of inertia Radius of gyration.
UNIT:4 [10 Hours] DYNAMICS OF PARTICLES Rectilinear motion: uniform velocity and uniformly accelerated motion Newton second law D'Alembert's principle and its applications work and energy equation Impulse and Momentum Impact of elastic bodies.
Teaching Methods: Chalk& Board/ PPT/ Guest Lecture
Text Books: 1. Timoshenko, and Young, "Engineering Mechanics", Tata Mc Graw Hill Book 2. S. S. Bhavikatti, "Engineering Mechanics", New Age International
Ref. Books: 1. Dr. Bansal.R.K, & Sanjay Bansal, "A Text book of Engineering Mechanics", Lakshmi publications. 2. A.K.Tayal, "Engineering Mechanics Statics And Dynamics", Umesh Publications 3. Rajasekaran.S, & Sankarasubramanian.G, "Engineering Mechanics", Vikas Publishing House Pvt Ltd, 2011 4. Engineering Mechanics, (3ed edition) by Statics and Dynamics K.Vijaya Kumar Reddy and J Suresh Kumar, BS Publications.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1032	**BASICS OF THERMODYNAMICS**	**3**	**0**	**0**	**3**	**A**

Pre-requisites :Physics, Chemistry and Mathematics

Course Educational Objectives

CEO1	Learn to classify the fundamentals of thermodynamics like pressure, temperature etc.
CEO2	Apply principle and law of thermodynamics to analysis of different systems
CEO3	Become aware of relevance of environmental and social issues on the analysis process of systems.
CEO4	To understand the basics of properties of pure substance like steam and its conditions and Application of Thermodynamics in engineering practices

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2	Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3	Interpret and apply the concept of entropy to thermodynamic systems
CO4	Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	3												
CO3	2	3												
CO4	3	3												
Avg.	2.5	2.75												

SYLLABUS

UNIT 1 (15 Hours)

Basic concepts & definition, scope of thermodynamics. Macroscopic & microscopic approach. Definition of fixed mass (closed) system & control volume (open) system, isolated system. Thermodynamic properties (extensive & intensive), state & its representation on a property diagram, process and its representation, cyclic process Characteristics of properties (point & path function), reversible & irreversible process, Quasistatic Process. Thermodynamic equilibrium. Pressure, Types of pressure, Zeroth law of thermodynamics & temperature scales, calibration of thermometers. Ideal gasses & their P

V T relation. Energy transfer; Work transfer(definition & calculation), different modes of work Displacement work for various process, Free expansion work, Heat transfer; modes of heat transfer, basic laws in conduction, convection & radiation.

UNIT 2 (13 Hours)

First law of thermodynamics, formal statement (using cyclic process) first law for processes of fixed masses (closed system) Introduction of internal energy, enthalpy as thermodynamic properties Definition of sp.heats (C_p & C_v) and their use in calculation of internal energy & enthalpy with emphasis on ideal gas. Application of first law to control volume (Steady Flow); nozzle, diffuser, compressor, turbine, throttling device.

UNIT 3 (12 Hours)

Second law of thermodynamics, Kelvin Planck & Clausius statements, Carnot cycle. Reversible & irreversible engines and their efficiency (Thermal and maximum Efficiency) Entropy concepts, Clausius inequality, Entropy Principle.

UNIT 4 (10 Hours)

Properties of pure substance, P v, T s, h s diagram for steam , Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Application of thermodynamics: Steam power plant, Refrigerators and Heat Pump, I C Engines (working principle with schematic diagrams only)

Teaching Methods: Chalk& Board/ PPT

Text Books:

1 Engineering Thermodynamics by P.K.Nag, Publisher: TMH
2 Basic Engineering Thermodynamics by D S Kumar, Publisher: S K Kataria & Sons New Delhi.

Ref. Books:

1. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI
2. Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles Publisher: Mcgraw Hill Education
3. Thermal engineering by R.K.Rajput, Laxmi Publications Pvt. Ltd.
4. Steam Tables in SI Units by K. Ramalingam, Scitech Publications (P) Ltd.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1041	**BASICS OF ELECTRONICS**	**3**	**0**	**0**	**3**	**A**

Pre-requisites (if any):

Course Educational Objectives

CEO1	Identify the basic tools and test equipment used to construct, troubleshoot, and maintain standard electronic circuits and systems.
CEO2	Explain the construction and application of standard circuit configurations and identify the component types and connections used to build functioning electronic circuits.
CEO3	Design simple combinational and sequential logic circuits
CEO4	Identify functions of digital multimeter, cathode ray oscilloscope and transducers in the measurement of physical variables

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Recognize different components such as transistors, resistors, capacitors and diodes which fit on a small chip with each leg of the chip connecting to a point within the circuit.
CO2	Apply modern modelling software for drafting different electronic circuits.
CO3	Analyze modern electronic circuits and systems.
CO4	Formulate mathematical descriptions and procedures in designing new electronic systems and technically present

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2			2											
CO3			2											
CO4	2		2											
Avg.	0.75		1.5											

SYLLABUS

UNIT-1

Semiconductor Devices:- Classification of material, Energy band diagram, properties of semiconductors, Types of semiconductors, Semiconductor diode (no bias, forward, reverse),temperature effects, diode equivalent circuit, zener diode, LED , Half wave rectifier, full wave rectifier, clippers ,clampers.

UNIT-2

Bipolar Junction Transistors (BJTs):- Introduction, transistor operation, Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Common–Base configuration, Common–emitter configuration, Common-collector configuration Current-voltage characteristics of BJT, BJT as an amplifier and as a switch.

Field Effect Transistors (FETs):- Introduction, construction and characteristics of JFETs, transfer characteristics, D-MOSFET, E –MOSFET.

UNIT-3

Communication Systems: -Analog and digital signals, block diagram of basic communication system, need for modulation, methods of modulation,AM/FM transmitters & receivers (Block diagram description only)

Electronic Instruments:- Basic principle of Oscilloscope, Function of the sweep generator, Block diagrams of oscilloscope, Measurement of frequency and phase by Lissajous method, Application of oscilloscope for measurement of voltage, period and frequency, Block diagram of standard signal generator, AF sine and square wave generator, and Function generator.

UNIT-4

Digital Systems and Binary Numbers:-Digital systems, Binary numbers, number system conversion, octal &hexa decimal number, 1's& 2's compliments, signed binary numbers, binary codes, binary logic.

Logic Gates and Boolean Algebra:- The inverter, The AND, OR, NAND NOR, Exclusive-OR and Exclusive-NOR gate, Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table Combinational Logic and Their Functions: Basic combinational logic circuits, Implementation of combinational logic, The universal properties of NAND and NOR gates, Basic adders

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092 (Selected Portions).
2. Digital Fundamentals (Eighth Edition), Thomas L. Floyd and R.P. Jain, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.
3. Electronic Instrumentation, H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books:

1. Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith, Oxford University Press, YMCA Library Building Jai Singh Road, New Delhi – 110 001.

2. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.
3. Electronics Principles (7th Edition), Albert Malvono and David J. Bates, Tata McGraw-Hill Publishing Company Limited, New Delhi.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1042	BASICS OF ELECTRICAL ENGINEERING	3	0	0	3	A

Pre -Requisite: Physics and Mathematics

Course Educational Objectives

CEO1	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
CEO2	This course provides comprehensive idea about DC & AC circuit analysis, magnetic circuit analysis, working principles of machines and common measuring instruments.
CEO3	Emphasize the effects of electric shock and precautionary measures. Improve the ability to function on multi-disciplinary teams.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the basic concepts of magnetic, AC & DC circuits.
CO2	Explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
CO3	Gain knowledge about the fundamentals concepts of power generation, domestic wiring, electric shock and preventive measures
CO4	Understand Electrical power generation and transimission process in India and function on multi-disciplinary teams.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												
CO2	1	2												
CO3	2	2												
CO4	1	1												
Avg.	1.5	1.75												

SYLLABUS
UNIT-1 (15 Hours) DC Circuits: Introduction to electrical terminology, Ohm's Law, Equivalent Resistance, series-parallel circuits, star-delta transformation, types of elements, ideal and practical voltage & current sources; Kirchhoff's Law, Mesh and Nodal Analysis. Network theorems: Superposition Theorem, Thevenin theorem, Maximum power transfer theorem excited by independent sources, Transients in RL & RC series circuits.
UNIT-2 (13 Hours) Single phase & Three phase Ac circuits: AC Fundamentals: RMS & Average value, form and peak factors, Complex algebra, concepts of reactance, impedance and their representation, AC through pure R, L, C, series RL, series RC, series RLC circuit, Concept of power & power factor; expression of power in complex notation. Three-phase AC circuits: Comparison between 1-ph & 3-ph AC circuit, Star & Delta connection, relation between line and phase quantities, Measurement of 3-phase power using 2-wattmeter method. Magnetic circuits: Magnetic flux, Magnetic flux density, Magnetic fields intensity, Relation between B & H, B-H curve, Analogy between Electric and Magnetic circuit, Leakage flux.
UNIT-3 (12 Hours) DC Machines: Introduction, working principle of DC Generator, Construction, Types, EMF equation, working principle of DC Motor Back e.m.f, Application of DC machines. AC Machines: Introduction, Principle of operation of AC machines, Transformers, Construction, EMF equation, Turn ratio, Ideal transformer on no load with phasor diagram, 3-phase Induction motor principle of operation, Rotating magnetic field, Types of rotors, Synchronous speed and slip, Introduction to 1-phase Induction motor, 1-phase motors types, appli cations of 3-phase and 1-phase motors, AC generator and motors, Principle of operation, types of rotors, Synchronous motor operating principle.
UNIT-4 (10 Hours) Measuring Instruments: Introduction, Classification of instruments, construction and working principles of PMMC and moving iron type Instruments. Introduction to Power System &Domestic Wiring: General layout of electrical power system and functions of its elements, Generation of electricity (Hydro, Thermal and Nuclear power plant), standard transmission and distribution voltages, Service main, Meter board, Fuse, MCB, Earthing (pipe & plate earthing), House wiring, Electric shock & precautions.
Teaching Methods: Chalk& Board/ PPT
Text Books: 1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International. 2. P.V. Prasad, S.Sivanagaraju, R.PrasadBasic Electrical and Electronics Engineering; CENGAGE Learning. 3. I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill

4. D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill.

Reference Books:

1. Edward Hughes, " Electrical Technology" Longman
2. T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press.
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc Graw Hill.
5. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath PHI.
6. Fundamentals of Electrical Engineering and Electronics by B. L. Theraja, S. Chand & Company Ltd, Reprint Edition 2013.

COURSE CODE	COURSE TITLE	L	T	P	C	QP
BBSES1050	PROGRAMMING IN 'C'	3	0	0	3	A

Pre -Requisite:

Course Educational Objectives

CEO1	To develop programming for solving problems using decision structures and loops, applications using arrays, solving scientific problems using functions.
CEO2	To design applications using pointer and structures.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Develop the algorithms, apply them using C by compiling, debug and analyzing programs for solving problems and to understand the basic concepts and decision structures required to design programs.
CO2	Design programs on loops for solving problems and develop applications using array data structure.
CO3	Develop applications using string operations and solve scientific problems using functions.
CO4	Make use of pointers to design applications and projects, dynamic memory allocation for efficient use of memory and design programs in projects involving structure.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2											
CO2	3	3	3	1										
CO3	3	3	3	1										

CO4	3	2	2											
Avg.	3	2.75	2.5	0.5										

SYLLABUS

UNIT- I (11 Hours)

Introduction to Programming Language, Structured Programming Approach, Basic structure of C program, C compilers, Compilation and Execution Process, Error debugging.

Tokens in C: keywords, identifiers, data types, constants, variables, standard I/O statements, Operators: arithmetic operators, assignment operators, increment and decrement operators, relational operators, logical operators, conditional operator, bit-wise operators, Operator precedence and associativity, Type casting: Implicit and Explicit type casting.

Control Flow Statements: Selection Logic: if, if..else, else if ladder, nested if, switch case,

UNIT- II (11 Hours)

Iteration Logic: while, do-while and for loop, break, continue, nested loop, goto statement.

Arrays:

Types of Arrays, 1-D Array: declaration, initialization, array operations, 2-D Array: declaration, Initialization, 2-D array operations,

UNIT- III (13 Hours)

1-D character array: String handling and string handling library functions. 2–Dcharacter array.

Functions:

User Defined Function: function prototype, function definition, function call, return statement, types of parameters, Function categories. Recursive functions, function with 1-D and 2-D array, nesting of functions, Storage classes: auto, register, static, extern

UNIT- IV (13 Hours)

Pointers: Declaration and initialization of pointers, Pointer arithmetic, Pointer and Arrays, Advantages of character pointer , Array of Pointers, Pointers and Functions: call by value and call by address, Function returning pointer, pointer to function, Pointer to Pointer, Dynamic memory allocation.

User Defined Data Types: typedef, enumeration , structures : Declaration and initialization of structures, accessing structure elements , nested structures, structures and arrays, structures and functions, structure and pointers, self- referential structures, structures with bit fields, Union: Declaration and initialization of Union, accessing union elements, structure with union.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

1. C Programming By E. Balagurusamy, Tata McGraw Hill Publications
2. Let us C by Yashavant P. Kanetkar, BPB Publications
3. Programming with C : Schaum's Outline Series by Byron Gottfried and Jitender Chhabra, Tata McGraw Hill Publications

References:

1. Exploring C by Yashavant P. Kanetkar, BPB Publications
2. C: The Complete Reference : By Herbert Schildt, Tata McGraw Hill Publications

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSHS 1060	**COMMUNICATIVE ENGLISH-I**	**2**	**0**	**0**	**2**	**A**

Pre -Requisite: fundamentals of grammar, vocabulary, usage of internet

Course Educational Objectives

CEO1	To promote communication skills and soft skills.
CEO2	To enhance the employability and entrepreneurial skills
CEO3	To motivate the students to participate in group discussions without stage fear

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the importance of effective communication for professional development
CO2	Application of vocabulary and grammar for effective communication.
CO3	Application of Information and Communication Technology(ICT) for career development
CO4	Nurture and motivate positive attitude towards placements.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								1		3				
CO2										1		2		

CO3								2			3			
CO4									3			1		
Avg.								0.75	0.75	1	0.75	0.75		

SYLLABUS

UNIT -1 Importance of English for Communication in the 21st Century (9 Hours)

1.1 Role of English in enhancing employability and entrepreneurial skills

1.2 The Nature and Scope of Communication

1. 3 Objectives of Communication: Information, advice, suggestion, order, motivation, persuasion, warning, negotiation, decision-making, etc. through English Language skills, i.e., LSRW skills

1.4 The process of communication and factors that influence communication: Sender, receiver, channel, code, topic, message, context, feedback, noise, filters and barriers (steps such as Ideation, Encoding, Transmission, Decoding, etc. need to be dealt with); Audience and purpose

1.5 Types of Communication: General and Professional Communication; Formal and Informal Communication; Verbal and Non-verbal communication; Intrapersonal and Interpersonal communication; Written communication and Spoken communication.

UNIT -2. English Vocabulary, Grammar & Usage (8 Hours)

2.1 Synonyms and Antonyms

2.2 Words often confused

2.3 Technical terms and one word substitutes

2.4 Idioms and Phrasal Verbs

2.5 Identify common errors in English.

2.6 Communicative use of the Passive Voice

2.7 Difference between American, British and Indian English (Vocabulary based) 1

UNIT- 3. Introduction to Corporate Communication (10 Hours)

3.1 Seven C's communication

3.2. Ten C's of Non-communication.

3.3 Corporate Communication – Direction of Communication: Downward Communication, Upward Communication, Horizontal/Lateral Communication, Diagonal Communication

3.4 Communication challenges in today's work place: Advances in technology; culturally diverse workforce; Team-based organizational Settings; how to overcome these challenges

3.5 Information and Communication Technology (ICT) and the corporate world, Power point presentation using multimedia; Internet and Intranet; Fax; Teleconferencing; Videoconferencing;

3.6 Corporate/Business etiquette: Good listening skills, proper dressing and grooming; proper handshake, mobile etiquette, table manners

UNIT- 4 Soft skills Development. (9 Hours)

4. 1 Importance of soft skills in personal and professional life

4.2 Are we hardwired for success?

4.3 Importance of developing a positive attitude

4.4 Leadership skills.

4.5 Teamsmanship.

4.6. Lateral thinking

4.7 Emotional Intelligence.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *An Introduction to Professional English and Soft Skills* by B. K. Das et al., Cambridge University Press.
2. *Communicative English for Engineers and Professionals* by Nitin Bhatnagar and Mamta Bhatnagar. Published by DK/Pearson.
3. Practical English Usage. Michael Swan, OUP,1995.

Reference Books:

1. Technical Communication , Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press
2. Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh. Pearson.
4. Oxford Guide to English Grammar by John Easthood. Oxford University Press.
5. 365 Ways to Change Your World by Norman Vincent Peale by Orient Paperbacks.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1121	**ENGINEERING PHYSICS LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives	
CEO1	Students will understand the basic principles of physics and their mathematical description.
CEO2	Students will be able to use the laws of physics and calculus to solve problems
CEO3	Students will be able to work together in collaborative groups to perform experiments, gather data and reach conclusions.
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand the uses of various Basic Instruments for different Physical measurements.
CO2	Apply the Physical Laws and verify those using standard Experiments.
CO3	Organize experiments to determine different Physical quantities and anlyze those for different application to Physical Systems.
CO4	Evaluate the magnitudes of Physical quantities systematically through

	experiments and design new experiments with the theoretical knowledge

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3	2											
CO2					3		1							
CO3		3			1									
CO4	3		2											
Avg.	0.75	1.5	1		1		0.25							

SYLLABUS

List of Experiments:

1. Study of frequency of an electric tuning fork by meld's experiment.
2. Study of the acceleration due to gravity by using Bar/Kater's pendulum.
3. Study of the law of transverse vibration by using sonometer.
4. Study of wavelength of light by Newton's Rings apparatus.
5. Study of wavelength of light by Fresenel's bi-prism/Michelson inter ferometer.
6. Study of grating element of a plane diffraction grating.
7. Study of double slit interface due to He-Ne laser.
8. Study of monochromaticity and divergence of the given laser beam
9. Study of reflection and total internal reflection by optical fibers
10. Study of Hall-coefficient of a semiconductor
11. Study of dielectric constant of given solid by Leacher wire method.
12. Study of the resistivity of a semiconductor with temperature by four- probe method.
13. Study of band gap energy of PN junction (Ge/Si) diode.
14. Study of plank's constant using photo-voltaic cell.
15. Study of B-H curve of ferromagnetic substance.
16. Study of magnetic susceptibility of solods.

LAB CODE	**NAME OF THE LAB**	**L**	**T**	**P**	**C**	**QP**
BBSBS1122	**ENGINEERING CHEMISTRY LAB**	**0**	**0**	**2**	**1**	

Course Educational Objectives	
CEO1	To train the students about the applications of chemical sciences in the field of engineering and technology
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand the basic methods of chemical analysis and instrumentations involved
CO2	Standardize of Chemicals
CO3	Estimate the hardness, ions in salts and compositions in ores.
CO4	Synthesizes the drugs and know about their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2

CO1		2		2			2		2		3			
CO2							3		3		2			
CO3		2		2			2		2		2			
CO4		2		2			2		2		2			
Avg.		1.5		1.5			2.25		2.25		2.25			

SYLLABUS

List of Experiments:

1. Determination of total hardness of water by using EDTA.
2. Determination of amount of NaOH and Na_2CO_3 present in mixture of two.
3. Standardization of $KMnO_4$ using sodium oxalate.
4. Determination of ferrous ion in Mohr's salt by standardized $KMnO_4$.
5. Determination of % of dissolved oxygen in given water sample.
6. Estimation of available chlorine in bleaching powder solution.
7. Determination of rate constant of acid catalyst Hydrolysis reaction.
8. Preparation of aspirin
9. Estimation of calcium in limestone.
10. Estimation of Zinc in brass.
11. To determine the strength of HCl and acetic acid from the mixture of acid by strong alkali (NaOH) by Conductrometry
12. Preparation of nanoparticle.
13. Determination of partition coefficient of iodine in benzene and water.
14. Preparation and determination of pH of buffer solution.
15. To determine the molecular weight of polymer by viscosity measurement.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1141	BASICS OF ELECTRONICS LABORATORY	0	0	2	1	

Course Educational Objectives	
CEO1	To provide students engineering skills by way of breadboard circuit design with electronic devices and components.
CEO2	To design and analyze various Electronic circuits such as multivibrators, applications of operational amplifiers, RC coupled amplifiers, oscillators, digital circuits etc. so that students are able to understand the practical aspects of basic electronics theory.
CEO3	To enable the students to simulate and test the Analog, Digital and mixed Electronics circuits .

Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Generate sine, square and triangular waveforms with required frequency & amplitude using function generator.
CO2	Demonstrate introductory knowledge of software for schematic capture, circuit simulation, and circuit board layout.
CO3	Analyze the characteristics of different electronic devices and circuits such as diodes, transistors, rectifiers, amplifiers etc.,
CO4	Plan new electronic systems and technically present them

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1											
CO2		2	2											
CO3		1	1											
CO4		2	2											
Avg.		1.5	1.5											

SYLLABUS

List of Experiments:

EXPERIMENTS: 1 Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi meter)

EXPERIMENTS: 2 Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.

EXPERIMENTS: 3 V-I characteristics of semiconductor diode

EXPERIMENTS: 4 Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.

EXPERIMENTS: 5 Studies on clipper circuit.

EXPERIMENTS: 6 Studies on clamper circuit.

EXPERIMENTS: 7 V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).

EXPERIMENTS: 8 MOSFET I-V characteristics

EXPERIMENTS: 9 Studies on Logic gates (Truth table verification of various gates).

EXPERIMENTS: 10 Studies and experiments using ADDER CIRCUITS ICs

LAB CODE	**NAME OF THE LAB**	**L**	**T**	**P**	**C**	**QP**
BBSES1142	**BASIC ELECTRICAL ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives	
CEO1	To know the basic concepts on different types of circuits.
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Illustrate the transformers and single phase motors constructional features
CO2	Analyse various electrical quantities with combination of loads

CO3	Examine the characteristics of AC and DC machines
CO4	Distinguish the methods of speed control of DC motors

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	2											
CO2		2	2											
CO3		1	2											
CO4		2	2											
Avg.		1.5	2											

SYLLABUS

List of Experiments:

1. Study of different electrical equipment's(transformer, single phase motors)
2. Power factor improvement using capacitor for fluorescent lamp.
3. Verification of Superposition and Thevenin's theorem
4. Measurement of reactive power by using single watt-meter method
5. 3phase Power measurement by using two wattmeter methods.
6. Calculation of current, voltage and power in series R-L-C circuit excited by single-phase AC supply and calculation of power factor.
7. Determination of open circuit characteristics (OCC) of DC shunt generator
8. Starting and speed control of a dc shunt motor by (a) field flux control method, and (b) armature voltage control method.
9. V-I characteristics of incandescent lamps and time-fusing current characteristics of a fuse.
10. Connection and testing of a single-phase energy meter.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1150	**PROGRAMMING IN 'C" LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To provide the ability to understand how analyze a problem and finding logic, to

	write programs, compiling, tracing errors, executing programs.
CEO2	The students will be able to understand how to write effective codes using the concepts provided in C language.
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Develop the algorithms and then implement, compile and debug programs in C language for solving problems and to design programs on decision structures.
CO2	Design programs on loops for solving problems and to develop applications using arrays.
CO3	Develop applications using string operations and applying functions to solve scientific problems
CO4	Design applications using pointers, dynamic memory allocation and develop simple projects involving structure.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	1										
CO2	2	3	3	2										
CO3	2	3	3	2										
CO4	2	3	2	1										
Avg.	2	2.75	2	1.5										

SYLLABUS

Lab 1: Introduction to OS: Before starting experiments explain the facilities and operations of OS.

Lab 2: Introduction to the C compiler, Compilation and Execution Process & writing hello world program

Lab 3:

- WAP to input radius of a circle and Find the area, perimeter of it.
- WAP to input two numbers and swap them without using intermediate variable.
- WAP to input marks for physics, mathematic, chemistry, English by considering each subject have maximum 100 marks. Find and display their percentage.
- Write a program to accept Fahrenheit and calculate its equivalent Celsius.
- Write a program to input principle amount, no. of terms and rate of interest. Find simple interest.
- WAP to input three unequal numbers and find the greatest using conditional operator.
- Write a program to input a float value and display its integer part & fractional part separately.

Lab 4:

- Write a program to find greatest among three unequal numbers using else…if ladder.
- Write a program to find the real roots of a quadratic equation when three co-efficient values are given.
- Write a program to input a lower case alphabet and test whether it is vowel or consonant using switch..case
- Write a program to find the greatest among three numbers using switch..case.

Lab 5:

- Write a program to find the factorial of a given positive integer.

- Write a program to find the sum of individual digits of a positive integer.
- Write a program to generate Fibonacci series of N numbers.
- Write a program to find the greatest common divider of two positive numbers given.
- Write a program to accept a positive integer and test it for palindrome or not.

Lab 6:

- Write a program to calculate the following sum:

Sum = 1-(x^2)/2! +(x^4)/4! – (x^6)/6! + (x^8)/8! – (x^10)/10!

- Write a C program to display all the prime numbers exist between 1 to n, where n is the value supplied by the user.
- Write a program to generate the following pyramid.

```
        1
      1 2 3
    1 2 3 4 5
  1 2 3 4 5 6 7
```

- Write a program to generate the following pyramid.

```
          A
        A B
      A B C
    A B C D
  A B C D E
```

Lab 7:

- Write a program to accept 10 numbers in to an array and sort it in ascending order
- Write a program to accept 10 integers in to an array and find largest and smallest integers present in them.
- Write a program to input elements 4x4 matrix. Find the principal diagonal of them.
- Write a program to input values into two matrices A(3x4), B(4x3). Perform matrix multiplication and display the resultant matrix.

Lab 8:

- Write a program to accept a string and test whether it is palindrome or not using string handling functions
- Write a C program which contains three UDF's namely add(), subtract() and multiply(). Each function accepts two integers as their arguments and calculate and return the results
- Write a program to find greatest common divisor of two integers using recursive and non recursive functions.
- Write a program to accept 10 elements into an integer array. Find the largest element present using recursive function.

Lab 9:

- Write a program to create user defined function called swap having two integer pointers as its arguments and it has no return value. Call this function using call-by-address
- Write a program to input a set of n numbers into an integer array. Create an user defined function that accepts the array using pointer and finds number of prime numbers exist in the array
- Write a program to create an user defined function which accepts a string using a character pointer and performs the operations:
- Finds the length of the string ,Reverse the string.

Lab 10:

- Write a program to create an user defined function which accepts a matrix using a pointer and returns the address of largest element present in it
- Write a program to store 'n integers using dynamic memory allocation. Find the average value of the integers using a user defined function.
- Write a program to create a structure called complex to represent a complex number. Perform addition of two complex numbers using an UDF

Lab 11:

- Write a program to create a structure for employee code, name and salary. Store five employee details using structure array and display only employee names whose salary is greater than 25000
- Write a program to input 11 cricket players details using a structure array having members player name, team name, batting average. Create a function which will display the player names whose batting average>=7.

Lab 12:

- Write a program to create a structure for product having members like product code, product name, price and quantity. Create a structure pointer to allocate memory for five products using dynamic memory allocation. Store the product details and display.
- Write a program to create a structure student having members like rollno, name and percentage. Store five student details using structure array. Create an user defined function that accepts the student details using a structure pointer and displays the count how many first division students present.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSHS 1160	**COMMUNICATIVE ENGLISH-1 LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To develop the vocabulary and usage skills of students by practice
CEO2	To develop the communication skills of the students, especially Listening and Speaking skills.
CEO3	To enable students to participate in group discussions through proper listening and speaking.
CEO4	To enable students eliminate grammatical mistakes in speech and writing.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Memorize and explain a good range of vocabulary and usage .
CO2	Use grammar for effective speaking in GD and other formats of speaking
CO3	Able and defend in conversational and public speaking competencies.
CO4	Develop active listening and speaking skill in different real life situation

CO-PO & PSO Mapping

	PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1										2	1			
CO2									2	2				
CO3									2	2				
CO4										2		1		
Avg.									1	2	0.25	0.25		

SYLLABUS

Phonetics & Listening Skills 16 hours = 8 classes [2 listening tests x 10 marks = 20 marks]
Vowels, diphthongs, consonants, consonant clusters; The International Phonetic Alphabet (IPA); phonemic transcription; Problem sounds; Syllable division and word stress; Sentence rhythm and weak forms; Contrastive stress in sentences to highlight different words; Intonation: falling, rising, and falling-rising tunes; Listening to Newspaper reading/Video, etc.Listening with a focus on pronunciation (ear-training): segmental sounds, stress, weak forms, intonation & Listening for comprehension. Reading of English daily newspapers and self-development books be integrated listening and speaking activities.

Speaking skills 16 hours = 8 classes [4 speaking tests x 10 = 40 marks]

- Topics for 1 minute, 2 minutes, and 5 minutes speaking
- Pictures, Quotations, Attitude-testing Questions may be used.
- Summarizing/responding to handouts, articles, books, magazines and newspapers.

Individual/Group presentations/discussion on given topics

Soft skills development 14 hours = 7 classes [4 assignments x 10 = 40 marks]
Positive thinking (Teachers to engage game/activity-oriented classes)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1171	**ENGINEERING DRAWING**	**0**	**0**	**2**	**1**	

Pre –Requisite:

Course Educational Objectives

CEO1	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions
CEO2	To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Demonstrate the views of different solid object.
CO2	Construct projection of plane surface and solids.
CO3	Develop Sections of various Solids surface.
CO4	Identify the projection in isometric scale.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2										
CO2	1			3										
CO3	2			3										
CO4	1			2										
Avg.	1.5			2.5										

Unit 1

Introduction: Introduction to Standards for Engineering Drawing practice, Line work and Dimensioning. [1 – Sheets]

Co ordinate system and reference planes: Definitions of HP, VP, RPP & LPP. Selection of drawing size and scale. Representation of point and line. [1 – Sheets]

Unit 2

Orthographic Projections : Introduction, Definitions Planes of projection, reference line, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes. [1 – Sheets]

Orthographic Projections of Plane Surfaces (First Angle Projection Only): Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, hexagon and circle. [1 – Sheets]

Projections of Solids (First Angle Projection Only) : Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, cylinders and cones in different positions. [1 sheet]

Unit 3 [2 – Sheets]

Sections and Development of Lateral Surfaces of Solids : Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

Unit 4

Isometric Projection (Using Isometric Scale Only) : Introduction, Isometric scale, Isometric projection of tetrahedron, cones and spheres. [1 – Sheets]

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1172	ENGINEERING WORKSHOP	0	0	2	1	

Pre Requisite:

Course Educational Objectives

CEO1	To enable students to work on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces
CEO2	To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands on training is given in different sections

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain various safety precaution and use of various hand tools
CO2	Demonstrate the process configuration and basic mechanism of different machines like Lathe, Shaper and Milling machine.
CO3	Identify and apply suitable tools for machining processes including turning, thread cutting, facing, knurling and drilling.
CO4	Practice on manufacturing of components using workshop trades including fitting and welding

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			1										
CO2	2			2										
CO3	1			3										
CO4	1			3										
Avg.	1.25			2.25										

Unit 1

1. Safety Precaution: To study the various Safety precautions in workshop.
2. Fitting :

(i) Study of different hand tools and Machine tools used in fitting.
(ii) Preparation of a male and female fitting job by using different hand tools.

Unit 2

3. Machining:

(i) Study of various components and working principle of lathe machine
(ii) Preparation of a cylindrical job by lathe (turning, Thread cutting, knurling)
(iii) Study on Shaper and Milling Machine

Unit 3

4. Welding Practice :

(i) Hand on practice on Electric Arc Welding to prepare Lap Joint, Butt Joint, T Joint and Corner Joint .
(ii) Study of Oxyacetylene Gas welding and Gas cutting.

2ND SEMESTER

SL.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
7.	BS	BBSBS2010	Engineering Mathematics-II	3	1	0	4	A
8.	BS	BBSBS1021	Engineering Physics	3	0	0	3	A
		BBSBS1022	Engineering Chemistry					
9.	ES	BBSES1031	Basics of Mechanics	3	0	0	3	A
		BBSES1032	Basics of Thermodynamics					
10.	ES	BBSES1041	Basics of Electronics	3	0	0	3	A
		BBSES1042	Basics Electrical Engineering					
11.	ES	BBSES2050	Data Structure	3	0	0	3	A
12.	HS	BBSHS2060	Communicative English-II	2	0	0	2	A
PRACTICAL								
7.	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	
		BBSBS1122	Engineering Chemistry Laboratory					
8.	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	
		BBSES1142	Basics Electrical Engineering Lab					
9.	ES	BBSES2150	Data Structure Using C++ Laboratory	0	0	2	1	
10.	HS	BBSHS2160	Communicative English-II Laboratory		0	2	1	
11.	ES	BBSES1171	Engineering Drawing	0	0	2	1	
		BBSES1172	Engineering Workshop					
12.	HS	BBSHS2180	YOGA / Project Work	0	0	2	1	
TOTAL				**17**	**1**	**12**	**24**	

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP

BBSBS 2010	ENGINEERING MATHEMATICS-II	3	1	0	4	A

Pre -Requisite:

Course Educational Objectives

CEO1	To focus on partial derivative and its methods.
CEO2	To make them understand about laplace and fourier transform.
CEO3	To calculate the gradients and directional derivatives of functions of several variables
CEO4	To introduce the concept of Vector differentiation and integration that finds applications in various fields like solid mechanics, fluid flow, heat problems and potential theory

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	To know how to solve the partial differential equation by suitable method.
CO2	To Solve Ordinary differential and integral equation by using Laplace transform, Execute the technique of Fourier Integral and transform for learning in advanced Engineering Mathematics.
CO3	To relate gradient, curl and divergence and its application in fluid dynamics.
CO4	To evaluate multiple integrals by using Green's, Stokes' and divergence theorem to give physical interpretation of the curl and divergence of a vector field .

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3				2		1					1		
CO2	3	3			1									
CO3	2				1									
CO4	2				2							1		
Avg.	2.5	0.75			1.5		0.25					0.5		

SYLLABUS

UNIT - I (07 Hours)

INTRODUCTION OF PARTIAL DIFFERENTIAL EQUATIONS:

Formation of Partial differential equations, Linear partial differential equation of first order: Lagrange's linear differential equation, Non-Linear partial differential equation of first order by Charpit's method.

UNIT-II (20 Hours)

Laplace Transforms: Definition, existence of Laplace Transforms, Properties of Laplace Transforms, Evaluation of integrals by Laplace Transforms, Inverse transforms, convolution theorem, transforms of unit step function, unit impulse function, periodic function. Simple application to ordinary differential equations by Laplace Transform method, Definition of Fourier Integral and Fourier transform

UNIT - III (10 Hours)

Vector differential calculus: vector and scalar functions and fields, Derivatives, Curves, tangents and arc Length, gradient, divergence, curl and their simple application

UNIT – IV (13 Hours)

Vector integral calculus: Definition and evaluation of double integration and triple integration, Evaluation of line integral, Surface integral and volume integral and their applications, Transformations theorems- Green's Theorem in plane , Stoke's Theorem,Gauss Divergence Theorem and their applications.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Prescribed Books 1. Advanced Engineering Mathematics by E. Kreyszig, John Willey & Sons Inc. 10th Edition
References: 1. Higher Engineering Mathematics by B. V. Ramana , Mc Graw Hill Education. 2. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi. 3. Advanced Engineering mathematics by H. K. Dass.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1021	ENGINEERING PHYSICS	3	0	0	3	A

Pre – Knowledge in +2 Physics and Mathematics

Course Educational Objectives

CEO1	Providing fundamental knowledge about the oscillations and waves
CEO2	To familiar with structure and properties of materials.
CEO3	Providing knowledge of mathematical concepts to solve electromagnetic problems and fundamental information about Quantum mechanics with applications.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand and analyze the concept of oscillation and wave mechanics.
CO2	Describe the principle of lasing and optoelectronics devices in communication system..
CO3	Explain the ideas of crystal structure, crystal diffraction and classification of materials.
CO4	Interpret the fundamentals of electromagnetism and deduce the electromagnetic wave equations.
CO5	Express the basics of quantum mechanics and illustrate the quantum mechanical problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3	2											
CO2					3		1							
CO3		3			1									
CO4	3		2											
Avg.	0.75	1.5	1		1		0.25							

SYLLABUS

UNIT: 01 (12 Hours)

Interaction of Wave and Matter

Simple Harmonic Oscillator, Damped harmonic oscillator and Forced harmonic oscillator, and coupled oscillator, Waves and its Characteristics, Superposition of Waves, Interference by division of wave front (Bi-prism experiment) and division of amplitude (Newton's Ring experiment). Introduction to Diffraction, types of diffraction.

LASER, spontaneous & stimulated emission, Einstein's relation, Ruby Laser and He-Ne Laser, Semiconductor laser, application of Laser. Optical fiber, Acceptance angle, Numerical aperture, Skip distance, Step index and Graded index fibers, Attenuations in optical fibers, applications of optical fiber in communication systems.

UNIT: 02 (12 Hours)

Physics of Materials

Introductions to materials, Crystallography, Crystal structure, crystal direction and plane, Miller indices, Inter planar spacings, Reciprocal Lattice and its characteristics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, Bragg's law. Energy bands in solids (conduction band, valence band and Fermi level), Classification of materials on the basis of band theory. Magnetic properties of Materials & their applications. Nano materials and applications (particulates, thin films, nano structures, etc.)

UNIT: 03 (10 Hour) Electromagnetic theory and wave Review of grad, divergence and curl, Gauss divergence theorem and Stoke's theorem (no derivations), fundamental laws of electrostatics, magneto-statics and electromagnetism, displacement current and conduction current, Maxwell's equations. Electromagnetic wave and its characteristics, electromagnetic wave equation for free space and in charge free conducting medium, electromagnetic energy, Poynting vector and Poynting theorem.
UNIT: 04 (12 Hours) Quantum Mechanics Introduction to dual nature: Black body radiation, photoelectric effect, Compton effect (qualitative idea only), de-Broglie's hypothesis, Heisenberg's uncertainty principle and its application to non-existence of electron inside the nucleus and ground state energy of one dimensional harmonic oscillator, Basic postulates of Quantum Mechanics, Wave function and its characteristics, probability density , normalization, eigen values, eigen functions and expectation values, Schrödinger's equation (time dependent and time independent). Application of Schrödinger equation to one dimensional potential well, potential step and potential barrier (qualitative ideas).
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Engineering Physics by D. K. Bhattacharya and Poonam Tanden, Oxford University Press. 2. Engineering Physics, H K Malik and A K Singh, Tata McGraw Hill, MGH.
Reference Books: 6. Materials Science & Engg., V. Raghvan, Prentice Hall of India. 7. Concepts of Modern Physics, A. Beiser, S. Mahajan, S.R. Choudhary, Tata McGraw Hill. 8. Lasers & Optical engineering, P Dass, Narosa Publishers, Springer Publisher. 9. Engineering Physics by B. B. Swain and P. K. Jena, Kitab Mahal,Cuttack 10. Quantum Mechanics by SatyaPrakash, Kitab Mohal, etc. Kedar Nath Ram Nath Publisher

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS1022	**ENGINEERING CHEMISTRY**	**3**	**0**	**0**	**3**	**A**

Pre –Requisite: Chemistry

Course Educational Objectives

CEO1	To impart the knowledge of application of chemical sciences in the field of engineering
CEO2	To focus on microscopic chemistry in terms of atomic and molecular levels.
CEO3	The course aims at elucidating principles of applied chemistry in water treatment.
CEO4	To give detailed account about the reactivity of metals w.r.t prevention of corrosion.
CEO5	To enlighten the students with the applications of polymers.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Analyze microscopic chemistry in terms of atomic and molecular orbital and Explain the ranges of the electromagnetic spectrum by electronic transition
CO2	Identify water treatment techniques for domestic and industrial purposes
CO3	Compare types of corrosion, and it's control measures.
CO4	Understand various types of polymers, their preparation along with applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2		2	3							
CO2	3	3	1	2		2	3							
CO3	3	3	2	1		2	3							
CO4	3	3	2	1		2	3							
Avg.	3	2.75	1.75	1.5		2	3							

SYLLABUS

UNIT-1 ATOMIC AND MOLECULAR STRUCTURE (13 Hours)

Schrodinger's wave equation(no derivation), Significance of wave functions, Particle in a box, Application for conjugated molecule, Molecular Orbital theory and Energy level diagram for Diatomic molecules, Spectroscopic techniques and applications: Electronics spectroscopy, Vibrational and rotational spectroscopy of diatomic molecules.

UNIT-2 WATER CHEMISTRY (13 Hours)

Types of Hardness, Determination of Hardness by EDTA method, Treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Carbonate and phosphate conditioning, Colloidal conditioning, Calgon conditioning.

UNIT-3 CORROSION (10Hours)

Thermodynamic functions: Entropy, Free energy, Relation between E.M.F and free energy, The Nernst's equation and application, Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, Corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Inhibitors, Protective coatings: Galvanization and Tinning.

UNIT -4 POLYMER CHEMISTRY (12 Hours)

Introduction, polymer, Classification of polymers, Plastics: Thermosetting and thermo plastic, PVC, PE, PS, PMMA, PTFE, Bakelite,Nylon-6,6,Nylon-6, Fiber reinforced plastic.
*ADD-ON COURSES: Conducting Polymer (Polyaniline, Polyacetylene), Bio-Degradable

and Non-Bio Degradable polymer, Nano composite.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1.Engineering chemistry by Jain & Jain, Dhanpat Rai publishing company (p) Ltd
Reference Books: 1. A Text Book of Engineering Chemistry by S.S.Dara, S Chand Publishers. 2. A Text Book of Engineering Chemistry by SashiChawla, Dhanpat Rai Publishing house. 3. Text Book of Engineering Chemistry, 2nd edition, by R.Gopalan, D.Venkapaya & Sulochana Nagarajan, Vikas Publishing House Pvt. Ltd. 4. B. Tech Chemistry- I and II by P. K. Kar, S. Dash, B. Mishra kalyani publishers. 5. Physical Chemistry By P.W Atkins 6. Engineering Chemistry(NPTEL Web Book) by B . L Tembe, Kamaluddin and M.S. Krishna 7. Fundamentals of Molecular spectroscopy By C . N Banwell 8. University chemistry by B.H. Mahan

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1031	BASICS OF MECHANICS	3	0	0	3	A

Pre –Requisite: Physics, Mathematics

Course Educational Objectives

CEO1	To apply the established engineering method to complex engineering problem.
CEO2	To understand the vectorial and scalar representation of forces and moments.
CEO3	To evaluate the different forces exhibit in truss member.
CEO4	To obtain the knowledge on kinematics and kinetics of particle to analyze simple and practical problems

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Determine the resultant force and moment for given force system.
CO2	Evaluate the forces in members of trusses, frames and problems related to friction.
CO3	Analyze the properties of surface in relation to centroid and moment of inertia
CO4	Adapt the laws of motion, kinematics of motion and their interrelationship

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	3												
CO3	3	3												
CO4	2	3												
Avg.	2.5	2.75												

SYLLABUS

UNIT:1 [16 Hours]

STATICS OF PARTICLES

Fundamental concepts and principles of engineering mechanics. Resolution of forces Resultant of several concurrent forces Free body diagram. Principles of transmissibility. Moment of a force Varignon's theorem Equivalent system of forces Types of supports and corresponding reactions.

UNIT:2 [12 Hours]

ANALYSIS OF TRUSSES AND FRICTION

Introduction to Truss Analysis of Trusses Method of joints, Method of sections.
Laws of Friction Angle of Friction Angle of Repose Ladder and Wedge Friction

UNIT:3 [12 Hours]

PROPERTIES OF SURFACES

Determination of first moment area of plane figures by integration – Determination of centroid of composite figures by using standard formula.
Determination of second moment area of plane figures by integration Parallel and perpendicular axis theorems Determination of area moment of inertia of composite figures by using standard formula Polar moment of inertia Radius of gyration.

UNIT:4 [10 Hours]

DYNAMICS OF PARTICLES

Rectilinear motion: uniform velocity and uniformly accelerated motion Newton second law D'Alembert's principle and its applications work and energy equation Impulse and Momentum Impact of elastic bodies.

Teaching Methods: Chalk& Board/ PPT/ Guest Lecture
Text Books: 1. Timoshenko, and Young, "Engineering Mechanics", Tata Mc Graw Hill Book 2. S. S. Bhavikatti, "Engineering Mechanics", New Age International
Ref. Books: 5. Dr. Bansal.R.K, & Sanjay Bansal, "A Text book of Engineering Mechanics", Lakshmi publications. 6. A.K.Tayal, "Engineering Mechanics Statics And Dynamics", Umesh Publications 7. Rajasekaran.S, & Sankarasubramanian.G, "Engineering Mechanics", Vikas Publishing House Pvt Ltd, 2011 8. Engineering Mechanics, (3ed edition) by Statics and Dynamics K.Vijaya Kumar Reddy and J Suresh Kumar, BS Publications.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1032	**BASICS OF THERMODYNAMICS**	**3**	**0**	**0**	**3**	**A**

Pre –Requisite: Physics, Chemistry and Mathematics

Course Educational Objectives

CEO1	Learn to classify the fundamentals of thermodynamics like pressure, temperature etc.
CEO2	Apply principle and law of thermodynamics to analysis of different systems
CEO3	Become aware of relevance of environmental and social issues on the analysis process of systems.
CEO4	To understand the basics of properties of pure substance like steam and its conditions and Application of Thermodynamics in engineering practices

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2	Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3	Interpret and apply the concept of entropy to thermodynamic systems
CO4	Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	3												
CO3	2	3												
CO4	3	3												
Avg.	2.5	2.75												

SYLLABUS

UNIT 1 (15 Hours)

Basic concepts & definition, scope of thermodynamics. Macroscopic & microscopic approach. Definition of fixed mass (closed) system & control volume (open) system, isolated system. Thermodynamic properties (extensive & intensive), state & its representation on a property diagram, process and its representation, cyclic process Characteristics of properties (point & path function), reversible & irreversible process, Quasistatic Process. Thermodynamic equilibrium. Pressure, Types of pressure, Zeroth law of thermodynamics & temperature scales, calibration of thermometers. Ideal gasses & their P V T relation. Energy transfer; Work transfer(definition & calculation), different modes of work Displacement work for various process, Free expansion work, Heat transfer; modes of heat transfer, basic laws in conduction, convection & radiation.

UNIT 2 (13 Hours)

First law of thermodynamics, formal statement (using cyclic process) first law for processes of fixed masses (closed system) Introduction of internal energy, enthalpy as thermodynamic properties Definition of sp.heats (C_p & C_v) and their use in calculation of internal energy & enthalpy with emphasis on ideal gas. Application of first law to control volume (Steady Flow); nozzle, diffuser, compressor, turbine, throttling device.

UNIT 3 (12 Hours)

Second law of thermodynamics, Kelvin Planck & Clausius statements, Carnot cycle.

Reversible & irreversible engines and their efficiency (Thermal and maximum Efficiency) Entropy concepts, Clausius inequality, Entropy Principle.
UNIT 4 (10 Hours) Properties of pure substance, P v, T s, h s diagram for steam , Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Application of thermodynamics: Steam power plant, Refrigerators and Heat Pump, I C Engines (working principle with schematic diagrams only)
Teaching Methods: Chalk& Board/ PPT
Text Books: 1 Engineering Thermodynamics by P.K.Nag, Publisher: TMH 2 Basic Engineering Thermodynamics by D S Kumar, Publisher: S K Kataria & Sons New Delhi.
Ref. Books: 1. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI 2. Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles Publisher: Mcgraw Hill Education 3. Thermal engineering by R.K.Rajput, Laxmi Publications Pvt. Ltd. 4. Steam Tables in SI Units by K. Ramalingam, Scitech Publications (P) Ltd.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1041	BASICS OF ELECTRONICS	3	0	0	3	A

Pre-requisites (if any):

Course Educational Objectives

CEO1	Identify the basic tools and test equipment used to construct, troubleshoot, and maintain standard electronic circuits and systems.
CEO2	Explain the construction and application of standard circuit configurations and identify the component types and connections used to build functioning electronic circuits.
CEO3	Design simple combinational and sequential logic circuits
CEO4	Identify functions of digital multimeter, cathode ray oscilloscope and transducers in the measurement of physical variables

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Recognize different components such as transistors, resistors, capacitors and diodes which fit on a small chip with each leg of the chip connecting to a point within the circuit.
CO2	Apply modern modelling software for drafting different electronic circuits.
CO3	Analyze modern electronic circuits and systems.
CO4	Formulate mathematical descriptions and procedures in designing new electronic systems and technically present

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1			2		2							
CO2	1			2	3	1		1						
CO3														
CO4		2		3							1			
Avg.	0.25	0.75		1.25	1.25	0.25	0.5	0.25			0.25			

SYLLABUS

UNIT-1

Semiconductor Devices:- Classification of material, Energy band diagram, properties of semiconductors, Types of semiconductors, Semiconductor diode (no bias, forward, reverse),temperature effects, diode equivalent circuit, zener diode, LED , Half wave rectifier, full wave rectifier, clippers ,clampers.

UNIT-2

Bipolar Junction Transistors (BJTs):- Introduction, transistor operation, Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Common–Base configuration, Common–emitter configuration, Common-collector configuration Current-voltage characteristics of BJT, BJT as an amplifier and as a switch.

Field Effect Transistors (FETs):- Introduction, construction and characteristics of JFETs, transfer characteristics, D-MOSFET, E –MOSFET.

UNIT-3

Communication Systems: -Analog and digital signals, block diagram of basic

communication system, need for modulation, methods of modulation,AM/FM transmitters & receivers (Block diagram description only) Electronic Instruments:- Basic principle of Oscilloscope, Function of the sweep generator, Block diagrams of oscilloscope, Measurement of frequency and phase by Lissajous method, Application of oscilloscope for measurement of voltage, period and frequency, Block diagram of standard signal generator, AF sine and square wave generator, and Function generator.
UNIT-4 Digital Systems and Binary Numbers:-Digital systems, Binary numbers, number system conversion, octal &hexa decimal number, 1's& 2's compliments, signed binary numbers, binary codes, binary logic. Logic Gates and Boolean Algebra:- The inverter, The AND, OR, NAND NOR, Exclusive-OR and Exclusive-NOR gate, Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table Combinational Logic and Their Functions: Basic combinational logic circuits, Implementation of combinational logic, The universal properties of NAND and NOR gates, Basic adders
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092 (Selected Portions). 2. Digital Fundamentals (Eighth Edition), Thomas L. Floyd and R.P. Jain, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092. 3. Electronic Instrumentation, H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
Reference Books: 1. Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith, Oxford University Press, YMCA Library Building Jai Singh Road, New Delhi – 110 001. 2. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092. 3. Electronics Principles (7th Edition), Albert Malvono and David J. Bates, Tata McGraw-Hill Publishing Company Limited, New Delhi.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1042	BASICS OF ELECTRICAL ENGINEERING	3	0	0	3	A

Pre -Requisite: Physics and Mathematics

Course Educational Objectives

CEO1	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
CEO2	This course provides comprehensive idea about DC & AC circuit analysis, magnetic circuit analysis, working principles of machines and common measuring instruments.
CEO3	Emphasize the effects of electric shock and precautionary measures. Improve the ability to function on multi-disciplinary teams.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the basic concepts of magnetic, AC & DC circuits.
CO2	Explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
CO3	Gain knowledge about the fundamentals concepts of power generation, domestic wiring, electric shock and preventive measures
CO4	Understand Electrical power generation and transimission process in India and function on multi-disciplinary teams.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	2											
CO2		2	2											
CO3		1	2											
CO4		2	2											
Avg.		1.5	2											

SYLLABUS

UNIT-1 (15 Hours)

DC Circuits:

Introduction to electrical terminology, Ohm's Law, Equivalent Resistance, series-parallel circuits, star-delta transformation, types of elements, ideal and practical voltage & current sources; Kirchhoff's Law, Mesh and Nodal Analysis.

Network theorems:

Superposition Theorem, Thevenin theorem, Maximum power transfer theorem excited by independent sources, Transients in RL & RC series circuits.

UNIT-2 (13 Hours)

Single phase & Three phase Ac circuits:

AC Fundamentals: RMS & Average value, form and peak factors, Complex algebra, concepts of reactance, impedance and their representation, AC through pure R, L, C, series RL, series RC, series RLC circuit, Concept of power & power factor; expression of power in complex notation.

Three-phase AC circuits:

Comparison between 1-ph & 3-ph AC circuit, Star & Delta connection, relation between line and phase quantities, Measurement of 3-phase power using 2-wattmeter method.

Magnetic circuits:

Magnetic flux, Magnetic flux density, Magnetic fields intensity, Relation between B & H, B-H curve, Analogy between Electric and Magnetic circuit, Leakage flux.

UNIT-3 (12 Hours)

DC Machines:

Introduction, working principle of DC Generator, Construction, Types, EMF equation, working principle of DC Motor Back e.m.f, Application of DC machines.

AC Machines:

Introduction, Principle of operation of AC machines, Transformers, Construction, EMF equation, Turn ratio, Ideal transformer on no load with phasor diagram, 3-phase Induction motor principle of operation, Rotating magnetic field, Types of rotors, Synchronous speed and slip, Introduction to 1-phase Induction motor, 1-phase motors types, appli cations of 3-phase and 1-phase motors, AC generator and motors, Principle of operation, types of rotors, Synchronous motor operating principle.

UNIT-4 (10 Hours)

Measuring Instruments:

Introduction, Classification of instruments, construction and working principles of PMMC and moving iron type Instruments.

Introduction to Power System &Domestic Wiring:

General layout of electrical power system and functions of its elements, Generation of electricity (Hydro, Thermal and Nuclear power plant), standard transmission and distribution voltages, Service main, Meter board, Fuse, MCB, Earthing (pipe & plate earthing), House wiring, Electric shock & precautions.

Teaching Methods: Chalk& Board/ PPT/Video Lectures Expert/MOOCS

Text Books:

1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International.
2. P.V. Prasad, S.Sivanagaraju, R.PrasadBasic Electrical and Electronics Engineering; CENGAGE Learning.
3. I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill
4. D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill.

Reference Books:

1. Edward Hughes, " Electrical Technology" Longman
2. T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press.
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc Graw Hill.
5. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath PHI.
6. Fundamentals of Electrical Engineering and Electronics by B. L. Theraja, S. Chand & Company Ltd, Reprint Edition 2013.

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BBSES2050	DATA STRUCTURE	3	0	0	3	A

Course Educational Objectives

CEO1	Understand different searching and sorting methods and compare them in terms of performance and applications. Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications.
CEO2	Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications.
CEO3	Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Develop algorithms for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand different applications.
CO2	Understand different searching and sorting methods, Linked lists and them compare them in terms of performance and applications.
CO3	Understand the Binary Tree and its memory representation; analyze Binary search Tree and its applications, compare the BST with AVL Tree and examine the advantages.
CO4	Design Heap Tree, observe its applications in sorting. Understand the memory representation of graph; analyze traversal methods and applications of graph. Analyze the Hashing techniques in compare with other sorting techniques.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2											
CO2	3	2	3	1										
CO3	3	3	3	1										
CO4	3	3	1	1										
AVG.	2.75	2.5	2.25	0.75										

SYLLABUS

Unit I [12 hours]

Basic concepts: Data abstraction, Algorithm specification, Memory Representation of 1D and 2D Array.

Stack: Introduction to stack, basic operations and implementation of stack using arrays Queue: Introduction to linear queue, basic operations and implementation of linear queue using arrays, circular queue, basic circular queue operations & Representation of Double ended Queue.

Applications on stack – Recursion, infix to postfix conversion, Evaluation of postfix

Unit II [12 hours]

Searching: Linear search and Binary search using linear array

Sorting: Bubble sort, Insertion sort, Selection sort, Quick sort, Bucket Sort using linear array.

Linked Lists: Basic operations of singly, doubly and circular linked lists, implementation of stack and queue using singly linked list
Unit III [12 hours] Trees: Introduction, Terminology, Binary Trees, Representation of Binary Trees using arrays and linked lists, Binary tree traversals, Creation of binary tree from in-order & pre-order sequences - Creation of binary tree from in-order & post-order Binary Search Trees: definition, basic operations of BST (Searching, Insertion and deletion) Introduction to AVL trees, Height of an AVL Tree, Balancing AVL tree by rotations after insertions and deletions of a data node.
Unit IV [12 hours] Heaps: Introduction to binary heaps, definition of a Max-heap, Min-heap, creating Max-Heap, Applications: Heap sort, Priority queue Graphs: Definitions, Graph representation - Adjacency matrix, Incidence Matrix, adjacency lists, Graph Traversals (BFS & DFS), Single source shortest path algorithm (Dijkstra's Algorithm) Topological Sorting Hashing: Hashing Functions, Open hashing (chaining), closed hashing (Open addressing – linear probing, quadratic probing, double hashing), rehashing
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson publication 2. "Data structure in C" by Tanenbaum, PHI publication / Pearson publication. 3. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms "Tata McGraw Hill. 4. "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill.
Reference Books: 1. "Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press. 2. Data Structures, Algorithms And Applications In C++ 2nd Edition (Sartaj Sahni) 3. Data Structure Through C++ Edition-1st (Yashwant Kanitkar)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSHS 2060	COMMUNICATIVE ENGLISH-II	2	0	0	2	A

Course Educational Objectives

CEO1	To develop the communication skills and soft skills of the students
CEO2	To enhance the ability of the students to develop employability and entrepreneurial skills
CEO3	To enable students to successfully participate in GDs and PIs
CEO4	To make students communicate effectively using technologies and techniques
CEO5	To inculcate a sense of professionalism in students

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the nature and scope of corporate communication and try to be industry ready
CO2	Able to use language skills for professional growth
CO3	Distinguish fact from opinion in reading passages from different text books
CO4	Create professional documents like Resume, Job Application letter for their career needs

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								2	2	3				
CO2										3	2			
CO3						1				3				
CO4										3	1			
Avg.						0.25		0.5	0.5	3	0.75			

SYLLABUS

UNIT-1 Introduction to Technical Communication [7 hours]

1.1 Essence of Technical Communication 1

1.2 Nature and Scope of Technical Communication: 1 +1 +1

Technical Communication -- Interactive and Adaptable; Technical Communication -- Reader Centered; Technical Communication and teamwork; Technical Communication Has Ethical, Legal, and Political Dimensions; Technical Communication – its International and Cross-Cultural nature; Technical communication and use of ICT.

1.3 Need of Technical communication for career development 1

1.4 Computer Assisted Language Learning (CALL) – Self learning through use of technology, Effectiveness of CALL for developing English Language Skills; Use of Internet 1 +1

UNIT - 2 Career Communication [17 hours]

2.1. Career making: Setting Goals, SWOT analysis 1

2.3 Preparing a Résumé: Elements of a Résumé; Types of Résumés: Chronological Résumé, Functional Résumé; Use of job portals 1 +1 +1

2.4 Effective Job Application Letter/Cover letter 1 +1

2.5 Group Discussion 1 +1

2.6 Job Interview 1 +1 +1+1 +1

2.7 Effective Oral Presentation 1+1

2.7 Handling a Meeting 1+1
UNIT-3 Technical Approach to Reading [8 Hours] 3.1 Know your Reading speed; Advantages of speed reading 1 3.2 SQ4R Techniques of Reading 1+1 3.3. Techniques of Rapid reading: skimming, scanning 1+1 3.4 Understanding coherence and cohesion 1 3.5 Note taking, Mind maps 1+1
UNIT-4 Technical Writing [14 hours] 4.1 Writing a technical paper 1+1 4.2 Writing business letters – significance, purpose, structure and elements, layout; types of business letters 1+1+1+1 4.3 Memos 1+1 4.4 Business Reports and Technical proposals 1+1+1+1 4.5 Using the Social media for better communication 1+1
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall. 2. Technical Communication Today by Richard Johnson-Sheehan. Edition 5. Pearson. 3. Communicative English for Engineers and Professionals by Nitin Bhatnagar and Mamta Bhatnagar. Published by DK/Pearson.
Reference Books 1. Basic Communication Skills for Technology by Andre J. Rutherford, Pearson Education Asia, Patparganj, New Delhi. 2. Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers. 3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian 4. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press. 5. How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1121	ENGINEERING PHYSICS LABORATORY	0	0	2	1	

Course Educational Objectives

CEO1	Students will understand the basic principles of physics and their mathematical description.
CEO2	Students will be able to use the laws of physics and calculus to solve problems
CEO3	Students will be able to work together in collaborative groups to perform experiments, gather data and reach conclusions.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the uses of various Basic Instruments for different Physical measurements.
CO2	Apply the Physical Laws and verify those using standard Experiments.
CO3	Organize experiments to determine different Physical quantities and anlyze those for different application to Physical Systems.
CO4	Evaluate the magnitudes of Physical quantities systematically through experiments and design new experiments with the theoretical knowledge

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2		2					1	2			
CO2	3	3	3		3	3	1			2				
CO3		3	2	3	3					2				
CO4	3	3	3	3	3				2	3	3			
Avg.	2.25	3	2.5	1.5	2.75	0.75	0.25		0.5	2	1.25			

SYLLABUS

List of Experiments:

1. Study of frequency of an electric tuning fork by meld's experiment.
2. Study of the acceleration due to gravity by using Bar/Kater's pendulum.
3. Study of the law of transverse vibration by using sonometer.
4. Study of wavelength of light by Newton's Rings apparatus.
5. Study of wavelength of light by Fresenel's bi-prism/Michelson inter ferometer.
6. Study of grating element of a plane diffraction grating.
7. Study of double slit interface due to He-Ne laser.
8. Study of monochromaticity and divergence of the given laser beam
9. Study of reflection and total internal reflection by optical fibers
10. Study of Hall-coefficient of a semiconductor
11. Study of dielectric constant of given solid by Leacher wire method.
12. Study of the resistivity of a semiconductor with temperature by four- probe method.
13. Study of band gap energy of PN junction (Ge/Si) diode.
14. Study of plank's constant using photo-voltaic cell.
15. Study of B-H curve of ferromagnetic substance.
16. Study of magnetic susceptibility of solods.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSBS1122	**ENGINEERING CHEMISTRY LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To train the students about the applications of chemical sciences in the field of engineering and technology

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the basic methods of chemical analysis and instrumentations involved
CO2	Standardize of Chemicals
CO3	Estimate the hardness, ions in salts and compositions in ores.
CO4	Synthesizes the drugs and know about their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		2		2			2		2		3			
CO2							3		3		2			
CO3		2		2			2		2		2			
CO4		2		2			2		2		2			
Avg.		1.5		1.5			2.25		2.25		2.25			

SYLLABUS

List of Experiments:

1. Determination of total hardness of water by using EDTA.
2. Determination of amount of NaOH and Na_2CO_3 present in mixture of two.
3. Standardization of $KMnO_4$ using sodium oxalate.
4. Determination of ferrous ion in Mohr's salt by standardized $KMnO_4$.
5. Determination of % of dissolved oxygen in given water sample.
6. Estimation of available chlorine in bleaching powder solution.
7. Determination of rate constant of acid catalyst Hydrolysis reaction.
8. Preparation of aspirin
9. Estimation of calcium in limestone.
10. Estimation of Zinc in brass.
11. To determine the strength of HCl and acetic acid from the mixture of acid by strong alkali (NaOH) by Conductrometry
12. Preparation of nanoparticle.
13. Determination of partition coefficient of iodine in benzene and water.
14. Preparation and determination of pH of buffer solution.
15. To determine the molecular weight of polymer by viscosity measurement.

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1141	BASICS OF ELECTRONICS LABORATORY	0	0	2	1	

Course Educational Objectives

CEO1	To provide students engineering skills by way of breadboard circuit design with electronic devices and components.
CEO2	To design and analyze various Electronic circuits such as multivibrators, applications of operational amplifiers, RC coupled amplifiers, oscillators, digital circuits etc. so that students are able to understand the practical aspects of basic electronics theory.
CEO3	To enable the students to simulate and test the Analog, Digital and mixed Electronics circuits .

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Generate sine, square and triangular waveforms with required frequency & amplitude using function generator.
CO2	Demonstrate introductory knowledge of software for schematic capture, circuit simulation, and circuit board layout.
CO3	Analyze the characteristics of different electronic devices and circuits such as diodes, transistors, rectifiers, amplifiers etc.,
CO4	Plan new electronic systems and technically present them

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1											
CO2		2	2											
CO3		1	1											
CO4		2	2											
Avg.		1.5	1.25											

SYLLABUS

List of Experiments:

1. Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi meter)
2. Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
3. V-I characteristics of semiconductor diode
4. Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.
5. Studies on clipper circuit.
6. Studies on clamper circuit.
7. V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
8. MOSFET I-V characteristics
9. Studies on Logic gates (Truth table verification of various gates).
10. Studies and experiments using ADDER CIRCUITS ICs

LAB CODE	NAME OF THE LAB	L	T	P	C	QP
BBSES1142	**BASIC ELECTRICAL ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To know the basic concepts on different types of circuits.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Illustrate the transformers and single phase motors constructional features
CO2	Analyse various electrical quantities with combination of loads
CO3	Examine the characteristics of AC and DC machines
CO4	Distinguish the methods of speed control of DC motors

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	2											
CO2		2	2											
CO3		1	2											
CO4		2	2											
Avg.		1.5	2											

SYLLABUS

List of Experiments:

1. Study of different electrical equipment's(transformer, single phase motors)
2. Power factor improvement using capacitor for fluorescent lamp.
3. Verification of Superposition and Thevenin's theorem
4. Measurement of reactive power by using single watt-meter method
5. 3phase Power measurement by using two wattmeter methods.
6. Calculation of current, voltage and power in series R-L-C circuit excited by single-phase AC supply and calculation of power factor.
7. Determination of open circuit characteristics (OCC) of DC shunt generator
8. Starting and speed control of a dc shunt motor by (a) field flux control method, and (b) armature voltage control method.
9. V-I characteristics of incandescent lamps and time-fusing current characteristics of a fuse.
10. Connection and testing of a single-phase energy meter.

COURSE CODE	COURSE TITLE	L	T	P	C	QP
BBSES2150	**DATA STRUCTURE USING 'C++' LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite:

Course Educational Objectives

CEO1	Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications.
CEO2	Understand different searching and sorting methods and compare them in terms of performance and applications. Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications.
CEO3	Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand and implement the object oriented concepts by in developing the programs for different operations.
CO2	Develop programs for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand their applications.
CO3	Design code for different searching and sorting methods and analyze their performance.
CO4	Develop the codes for different operations on Linked lists and compare with other data structures.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	1	1									
CO2	2	3	3	3	2									
CO3	3	3	3	3	2									
CO4	2	2	3	3										
Avg.	2.25	2.5	3	2.5	1.25									

SYLLABUS

Lab1: introduction to OOPs (C++ features), cin, cout, object, class, Simple programs.

Lab2: Access Specifiers, inline, private, public, arrays of objects, programs on them.

Lab3: Experiment No.1

1) Write a C++ program to create a class called student to store your rollno, name, age. Create an array of object to input 5 students data and then display where age>=20.

Write a C++ program to create a class having methods for operations insertion, deletion and display to perform operations on 1D array of elements.

Lab4: Experiment No.2

Write a C++ program to create a class having methods: insertion, multiply and display for performing multiplication on a matrix of elements.

Lab5: Experiment No.3

Write a program using C++ to create a stack using class and perform:

(i) push operation (ii) pop operation (iii) display operation

Lab6: Experiment No.4

Write a C++ program that uses Stack operations to converting an infix expression into equivalent postfix expression.

Lab7: Experiment No.5

Write a C++ program to create a linear queue and perform the following operations: (i) insertion ii) deletion and iii) Traversal

Lab8: Experiment No.6

Write C++ programs that use both recursive and non-recursive functions to perform the linear & binary search operation for a Key value in a given list of integers.

Lab9: Experiment No.7

Write a C++ menu driven program to implement bubble sort, selection sort and insertion sort for a given list of integers in increasing order

Lab10: Experiment No.8

Write a C++ program to implement quick sort to a given list of integers to sort in ascending order.

Lab11: Experiment No.9

Write a C++ program that uses functions to perform the following operations on linear linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal

Lab12: Experiment No.10

Write a C++ program that uses functions to perform the following operations on Double linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSHS2160	**COMMUNICATIVE ENGLISH –II LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite:

Course Educational Objectives

CEO1	To develop the vocabulary and usage skills of students by practice.
CEO2	To develop the communication skills of the students, especially the Listening and Speaking skills.
CEO3	To enable students to participate in group discussions through proper listening and speaking.
CEO4	To enable students eliminate grammatical mistakes in speech and writing.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Build up a good range of vocabulary and know proper usage.
CO2	Become active listeners with good comprehension, participation, and evaluation.
CO3	Develop conversational and public speaking competencies.
CO4	Use grammar for effective speaking in GD and other formats of speaking.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1										2	1			
CO2									2	2				
CO3									2	2				
CO4					2					2		1		
Avg.					0.5				1	2	0.25	0.25		

SYLLABUS

Phonetics & Listening Skills 16 hours = 8 classes [2 listening tests x 10 marks = 20 marks]

Vowels, diphthongs, consonants, consonant clusters; The International Phonetic Alphabet (IPA); phonemic transcription; Problem sounds; Syllable division and word stress; Sentence rhythm and weak forms; Contrastive stress in sentences to highlight different words; Intonation: falling, rising, and falling-rising tunes; Listening to Newspaper reading/Video, etc.

Listening with a focus on pronunciation (ear-training): segmental sounds, stress, weak forms, intonation & Listening for comprehension. Reading of English daily newspapers and self-development books be integrated listening and speaking activities.

Speaking skills 16 hours = 8 classes [4 speaking tests x 10 = 40 marks]

- Topics for 1 minute, 2 minutes, and 5 minutes speaking
- Pictures, Quotations, Attitude-testing Questions may be used.
- Summarizing/responding to handouts, articles, books, magazines and newspapers.
- Individual/Group presentations/discussion on given topics

Soft skills development 14 hours = 7 classes [4 assignments x 10 = 40 marks]

- Positive thinking (Teachers to engage game/activity-oriented classes)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1171	ENGINEERING DRAWING	0	0	2	1	

Pre –Requisite:

Course Educational Objectives

CEO1	To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions
CEO2	To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Demonstrate the views of different solid object.
CO2	Construct projection of plane surface and solids.
CO3	Develop Sections of various Solids surface.
CO4	Identify the projection in isometric scale.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2										
CO2	1			3										
CO3	2			3										
CO4	1			2										
Avg.	1.5			2.5										

Unit 1

1. Introduction: Introduction to Standards for Engineering Drawing practice, Line work and Dimensioning. [1 – Sheets]
2. Co ordinate system and reference planes: Definitions of HP, VP, RPP & LPP. Selection of drawing size and scale. Representation of point and line. [1 – Sheets]

Unit 2

3. Orthographic Projections : Introduction, Definitions Planes of projection, reference line, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes. [1 – Sheets]
4. Orthographic Projections of Plane Surfaces (First Angle Projection Only): Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, hexagon and circle. [1 – Sheets]
5. Projections of Solids (First Angle Projection Only) : Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, cylinders and cones in different positions. [1 sheet]

Unit 3

6. Sections and Development of Lateral Surfaces of Solids : Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. [2 – Sheets]

Unit 4 7. Isometric Projection (Using Isometric Scale Only) : Introduction, Isometric scale, Isometric projection of tetrahedron, cones and spheres. [1 – Sheets]
Teaching Methods: Chalk& Board
TEXT BOOKS 1. Engineering Drawing N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat. 2. Computer Aided Engineering Drawing S. Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi 1. 3. Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSES1172	**ENGINEERING WORKSHOP**	**0**	**0**	**2**	**1**	

Pre Requisite:

Course Educational Objectives

CEO1	To enable students to work on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces
CEO2	To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands on training is given in different sections

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain various safety precaution and use of various hand tools
CO2	Demonstrate the process configuration and basic mechanism of different machines like Lathe, Shaper and Milling machine.
CO3	Identify and apply suitable tools for machining processes including turning, thread cutting, facing, knurling and drilling.
CO4	Practice on manufacturing of components using workshop trades including fitting and welding

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			1										
CO2	2			2										
CO3	1			3										
CO4	1			3										
Avg.	1.25			2.25										

Unit 1

1. Safety Precaution: To study the various Safety precautions in workshop.
2. Fitting :

(i) Study of different hand tools and Machine tools used in fitting.
(ii) Preparation of a male and female fitting job by using different hand tools.

Unit 2

3. Machining:

(i) Study of various components and working principle of lathe machine
(ii) Preparation of a cylindrical job by lathe (turning, Thread cutting, knurling)
(iii) Study on Shaper and Milling Machine

Unit 3

4. Welding Practice :

(i) Hand on practice on Electric Arc Welding to prepare Lap Joint, Butt Joint, T Joint and Corner Joint .
(ii) Study of Oxyacetylene Gas welding and Gas cutting.

III SEMESTER [SECOND YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
7.	BS	BBSBS3040	Engineering Mathematics – III	3	1	0	4	A
8.	PC	BMEPC3010	Mechanics of Solids	3	1	0	4	A
9.	PC	BMEPC3020	Fluid Mechanics & Hydraulics Machines	3	0	0	3	A
10.	PC	BMEPC3030	Introduction to Physical Metallurgy & Engineering Materials	3	0	0	3	A
11.	ES	BCSES3051	OOPS through JAVA	3	0	0	3	A
		BCSES3052	Database Management Systems					
12.	HS	BMGHS3061	Engineering Economics & costing	3	0	0	3	A
		BMGHS3062	Environmental Engineering & Safety					
PRACTICAL								
5.	PC	BMEPC3110	Mechanics of Solids Laboratory	0	0	2	1	
6.	PC	BMEPC3120	Fluid Mechanics & Hydraulics Machines Laboratory	0	0	2	1	
7.	PC	BMEPC3130	Introduction to Physical Metallurgy & Engg Materials	0	0	2	1	

			Laboratory					
8.	ES	BCSES3151	JAVA Programming Laboratory	0	0	2	1	
		BCSES3152	Database Management Systems Laboratory					
TOTAL				**18**	**2**	**8**	**24**	

SUBJECT CODE	**TITLE OF THE SUBJECT**	**L**	**T**	**P**	**C**	**QP**
BBSBS3040	**ENGINEERING MATHEMATICS – III**	**3**	**1**	**0**	**4**	**A**

Pre -Requisite: Fundamentals of complex numbers, series

Course Educational Objectives

CEO1	To test the nature of complex function
CEO2	To identify the different methods for complex integration
CEO3	To analyze error by using different methods.
CEO4	To know about different types of probability distributions.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	To know Analytic function and their properties.
CO2	To Evaluate Real Integral by using Series method
CO3	To apply numerical methods in Engineering Mathematical Problems
CO4	To investigate probability distribution problem to understand Binomial distribution, Poisson distribution and normal distribution.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2													
CO2	2	3													
CO3	2	3													
CO4	2	3													
Avg.	2	2.75													

SYLLABUS

UNIT:1 [12 Hours]
Complex Analysis:

Analytic function, Cauchy-Riemann equations, Harmonic Function, Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula.
UNIT:2 [8 Hours] Taylor's series, Laurent's series, Singularities and zeros, Residues, Cauchy Residue theorem, Evaluation of real integrals.
UNIT:3 [10 Hours] Numerical methods: Errors, Solving of algebraic and transcendental equations by using fixed point iteration and Newton-Raphson's method. : Newton divided differnterpolation,Lagrange interpolation ,Newton's forward and backward interpolation.Numerical Differentiation,Numerical integration:The trapezoidal rule, The simpson's rules, Ordinary differential equation: Modified Euler's method, Runge-kutta methods.
UNIT:4 [18 Hours] PROBABILITY: Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson and uniform distributions, Normal distribution, Random sampling, Estimation of Parameters (maximum likely hood method),Confidence intervals, Testing of hypothesis ,Acceptance sampling ,Regression and correlation analysis, fitting of straight line by least square method.
Teaching Methods: Chalk& Board
Text Books: 1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey 2. Numerical Methods by Jain and Iyengar.
Ref. Books: 1. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi. 2. Higher Engineering Mathematics by B.V.Ramana, McGraw Hills Education 3. Numerical Methods by Dutta and Jena.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC3010	**MECHANICS OF SOLIDS**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Basic mathematics and Engineering Mechanics						
Course Educational Objectives						
CEO1	To define the concept of load, stress, strain, stress vs strain diagram and elastic constant relationship.					
CEO2	To Solve engineering problems through the relationship between stress and strain.					
CEO3	To determine shear force and bending moment diagrams for variously loading conditions					
CEO4	Learn to solve problems for calculation of torsion and Twisting moment in solid and hollow circular shafts.					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Find the basic mechanical properties of material, tension, compression, torsion, bending and combined stress using the fundamental concepts of stress, strain and elastic behavior of materials.					
CO2	Apply the stress- strain distributions, diagrammatically representation of shear force & bending moment for different beams under various load conditions by using suitable methods.					
CO3	Analyze the slope and deflections for different cross sectional beams and columns, torsion effect for shaft and springs under different load conditions.					
CO4	Solve the engineering problems by applying mechanical engineering					

	concepts and theories.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	2												1
CO3	2	3												
CO4	2	2												1
Avg.	2.25	2.25												0.5

SYLLABUS

UNIT:1 [14 Hours]

Concept of stress: Load, Stress, Hook's law, poisson's ratio, Stress-strain diagram, working stress, Factor of safety, Principle of St. Venant , Principle of Superposition, Shear stress, Complimentary shear stress, Compound Bars, Shear strain, Modulus of rigidity, Modulus of elasticity, Relationship among elastic constants. Strain energy, Resilience, Impact load.Analysis of axially loaded members: Composite bars in tension and compression, Temperature stresses in composite rods, concept of statically indeterminate problems.

UNIT:2 [14 Hours]

Thin Cylinders: Thin Cylinders and Shells under internal pressure, wire winding of thin cylinder.Biaxial state of stress: Plane stress, principal plane, principal stress, Mohr's circle for biaxial stress , Calculation of Principal stresses from principal strain. Shear force and Bending moment diagram : Concept of Shear Force and Bending Moment, Types of load and types of support, Support reactions, Relationship between bending moment and shear force, point of inflection, Shear force and bending Moment Diagram.

UNIT:3 [10 Hours]

Bending of Beams: Theory of simple bending ,Bending stress, Shear stresses in beams, Distribution of shearing stress over a rectangular section, triangular section, I- section and T- section. Deflection of Beams: Differential equation of the elastic line, slope and deflection of beams by integration method

UNIT:4 [8 Hours]

Torsion : Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, Strength of solid and hollow circular shafts, Strength of shafts in combined bending and twisting, Close- coiled helical spring.

Teaching Methods: Chalk& Board

Text Books:

1. Elements of Strength of Materials by S.P.Timoshenko and D.H.Young, Affiliated East West Press.
2. Strength of Materials by S.S.Rattan, Tata Mc Graw Hill

Ref. Books:

1. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill.
2. Mechanics of Materials by R.C.Hibbeler, Pearson Education
3. Mechanics of Materials by William F.Riley, Leroy D.Sturges and Don H.Morris, Wiley Student Edition

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC3020	**FLUID MECHANICS & HYDRAULICS MACHINES**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Physics, Thermodynamics, Mechanics, Mathematics

Course Educational Objectives	
CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery
Course Outcomes: Upon successful completion of this course, students should be able to:	
CO1	Understand the basic properties and characteristics of incompressible fluid.
CO2	Apply basic fundamental theorems governing fluid flows i.e., continuity, energy and momentum.

CO3	Compare the concept of measurement of different fluid properties using various types of equipments like measurement of flow, pressure velocity and head loss.
CO4	Analyze the working of hydraulic machines and evaluate the performance of turbines and pumps

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	3	3												
CO3	2	2												
CO4	2	3												
Avg.	2.5	2.5												

SYLLABUS

UNIT:1 (10 Hours)

Scope of fluid mechanics and its development as a science Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer. Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

UNIT:2 (14 Hours)

Fluid kinematics:

Introduction, description of fluid flow, classification of fluid flow. Reynolds number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity, Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net

Fluid dynamics :

Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orificemeter, pitot tube. Flow in pipes and ducts: Loss due to friction, Minor energy losses in pipes Flow through nozzles.

UNIT:3 (13 Hours)

Impact of Jet: Introduction, Force exerted by the jet on a stationary and

movable plate (vertical, inclined, curved) Hydraulic turbines: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves.
Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation

UNIT:4 (8 Hours)

Centrifugal Pump: constructional features, vane shape, velocity triangles, Efficiencies, Pump Characteristic, NPSH and Cavitation. Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram

Teaching Methods: Chalk& Talk/ PPT/Video Lectures/Demonstration

Text Books

1. Fluid Mechanics - Frank M. White II
2. Fluid Mechanics - Yunus Cengel and John Cimbala
3. Introduction To Fluid Mechanics And Fluid Machines - S Chakraborty
4. Fluid Mechanics and Hydraulic Machines, Modi & Seth

Ref. Books

1.Fluid Mechanics and Fluid Machines by A.K.Jain, Khanna Publishers
2.Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH
3. Fluid Mechanics and Hydraulic Machines , Dr. R K Bansal, Laxmi Publication

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC3030	**INTRODUCTION TO PHYSICAL METALLURGY & ENGINEERING MATERIALS**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Solid physics

Course Educational Objectives

CEO1	To familiarize with the concept crystal structures, bonding of solids and their influence on properties of materials
CEO2	To acquaint with the construction of phase diagrams and describe the phase relationship with variables i.e. chemical composition, pressure, temperature etc
CEO3	To develop a fundamental understanding of the relationships between

	Composition-Structure-property –performance and processing of material
CEO4	To develop an understanding of the processes occurring in metals during heating that influences the microstructure and properties
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand the atomic arrangement in different crystallographic planes and directions and their influence on bonding strength of metals.
CO2	Ability to construct the phase diagram and interpret the phase relationship effect on properties of materials.
CO3	Analyze the effect of heat treatment on micro structural change on properties of different materials.
CO4	Apply the fundamental concepts to develop new materials for suitable applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2											1	
CO2	3	2												
CO3	3	3												
CO4	2	2											2	
Avg.	2.5	2.75											0.75	

SYLLABUS

UNIT:1 [16 Hours]

Classification of Engineering Materials, Characteristic property of metals, bonding in solids, ionic, covalent and metallic bond, Crystal systems, crystallographic planes and directions, atomic packing efficiency, crystal imperfection and voids in common crystal systems. Solidification of pure metal, Homogeneous and heterogeneous nucleation processes, cooling curve, concept of super cooling, microstructures of pure metals, solidification of metal in ingot mould.

UNIT:2 [12 Hours]

Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valence factor, crystal structure factor and chemical affinity factor; order-disorder trans formation. Binary phase diagrams a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d) Eutectoid system and (e) Peritectoid system. (f)Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems, Effect of non-equilibrium cooling, coring and homogenization. Iron-cementite and iron-graphite phase diagrams,

UNIT:3 [12 Hours]

Equilibrium cooling behaviour of hypo, eutectoid, hyper eutectoid steels. microstructure and properties of different alloys. Heat treatment of steels, i.e. annealing, normalizing,

hardening and tempering; microstructural effects brought about by these processes and their influences on mechanical properties; Concept of T.T.T diagram, factor affecting hardenability. Alloy steels: Stainless steel, tool steel, HSS, high strength low alloy steel, heat treatment, properties, microstructure and applications. Types of cast irons, their microstructures and typical uses. Concept of plastic deformation of metals, yield point phenomena, CRSS, Recovery recrystallization and grain.
UNIT:4 [10 Hours] Optical properties of Materials: Scattering, Refraction, Theory of Refraction and bsorption, Atomic Theory of optical properties. Lasers, Optical fibres- Principle, structure, application of optical fibres. Plastic-: Thermosetting and thermoplastics. Ceramics: Types, structure, Mechanical properties, application Composite Materials: Agglomerated Materials: Cermets .Reinforced Materials: Reinforced Concrete. Glass fiber reinforced plastics, Carbon fibre reinforced plastics, fibre reinforced plastics, laminated plastic sheets. Tefnol , Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite. Introduction to Nano-materials
Teaching Methods: Chalk& Talk,PPT
Text Books: 1. Introduction to physical metallurgy – Sydney Avner 2 Fundamentals of materials science and engineering W. Callister
Ref. Books: 1. Mechanical Metallurgy by Dieter, Tata MacGraw Hill 2. Engineering Physical Metallurgy and Heat Treatment by Y.Lakhtin, Mir Publisher, Moscow. 3 Physical Metallurgy by Vijayendrasingh.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BCSES3051	**OOPS THROUGH JAVA**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite:						
Course Educational Objectives						
CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism					
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections					

CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using java doc.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Ability to analyze ,formulate and model problems using concepts of object oriented analysis and design and implement using Java and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Analyze the problems and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Realize the power of generics and Collections Framework and Java.io package

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	3	2	2											
CO3	2	2	2											
CO4	2	1	2											
Avg.	2.5	1.5	1.5											

SYLLABUS

UNIT:1 (12 Hours)

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Data types, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

UNIT:2 (14 Hours)

Introduction to Classes and Objects. Constructors, static Keyword, this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance, Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.

UNIT:3 (14 Hours)

Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class. IO Streams (java.io package) , Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map.
UNIT:4 (14 Hours) Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/
Text Books: 1 Programming in Java. Second Edition. Oxford Higher Education. (Sachin Malhotra/ Saurav Choudhary) 2 Core Java For Beginners. (Rashmi Kanta Das), Vikas Publication
Ref. Books 1. JAVA Complete Reference (9th Edition) Herbalt Schelidt

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3052	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	A
Pre -Requisite:						
Course Educational Objectives						

CEO1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.
CEO2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
CEO3	Understand the use of Structured Query Language (SQL) and its syntax
CEO4	Apply Normalization techniques to normalize a database.
CEO5	Understand the need of Database processing and learn techniques for controlling the consequences of concurrent data access.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Identify and Classify the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	Apply the constraints in database using different query languages like:- relational algebra and calculus, SQL and QBE for the implementing the Data definition and data manipulate languages in Database.
CO3	Compare the different normal forms to Apply normalization process to construct the consistent Database.
CO4	Design and Develop the Database by inspecting concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	3	2												
CO3	2	2												
CO4	2	1												
Avg.	2.5	1.5												

SYLLABUS

UNIT:1 (15 Hours)

Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

UNIT:2 (13

Hours) Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation
UNIT:3 (10 Hours) Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.
UNIT:4 (12 Hours) Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques, fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.
Text Books: 1 Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education 2. Elmasari &Navathe: Fundamentals of Database System, Pearson Education.
References Books: 1. Elmasari &Navathe: Fundamentals of Database System, Pearson Education. 2. Ramakrishnan: Database Management Systems, McGraw-Hill Education. 3. Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education. 4. Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly Media

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS3062	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objectives

CEO1	The course introduces the students to the environmental consequences of industries
CEO2	To provide minimization of their impacts through technology and legal systems.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the ecological system of environment.
CO2	Learn about treatment of water/waste water
CO3	Discuss on the causes and remedies of environment pollution and technological approaches.
CO4	Elaborate the importance of environmental safety.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2		3	2	1										
CO3					2		3							
CO4					2		3							
Avg.		1	0.5	0.25	1		1.5							

SYLLABUS

UNIT:1 (10 Hours)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution Noise standards, measurement and control. Water Treatment: water quality standards and

parameters, Ground water. Water treatment processes, Pre treatment of water, Conventional process, Advanced water treatment process.
UNIT:2 (12 Hours) Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion ,Reactor configurations and methane production. Air Pollution: Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change – greenhouse gases, non criteria pollutants, Air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.
UNIT:3 (10 Hours) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing.
UNIT:4 (10 Hours) Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention Detection, Extinguishing Fire, Safety Management Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydro Carbons Wastes. Personal Protective Equipments.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely. 2. Environmental Engineering,, Nelson L NEMEROW, Franklin J,AGARDY,Patrick SULLIYAN and Joseph A. SALVATO. 3.Environmental Science and ethics, Smriti Srivastava, S.K Kataria and Sons publishers
Ref. Books 1. Environmental Engineering by Arcadio P. Sincero &Gergoria A Sincero PHI Publication. 2. Environmental Science, Curringham & Saigo, TMH

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMSHS3061	**ENGINEERING ECONOMICS & COSTING**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite:						
Course Educational Objectives						
CEO1	to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost					
CEO2	to help students to grasp various economics concepts and theories towards making economic decision.					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Understanding the fundamentals of economic theory in general concept of demand & supply, theories of production Laws of returns					
CO2	Overview of cost and revenue concepts: Understood the nature and behaviour of cost, cost sheet, Break even analysis linear approach and understanding of depreciation with its measurement.					
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.					
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.					
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.					
CO-PO & PSO Mapping						

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						1					2	2		
CO2						1					3	1		
CO3						1					3	2		
CO4						2					3	1		
Avg.						1.25					2.75	1.5		

SYLLABUS

UNIT:1 (12 Hours)

Engineering Economics –Meaning, Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics. Demand and Supply Analysis Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).Theory of Production Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 (10 Hours)

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis Linear approach (Simple numerical problems to be solved). Depreciation Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT:3 (12 Hours)

Time value of money Interest Analysis Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of engineering projects Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Sensitivity Analysis, Replacement Analysis Determination of economic life of an asset, Replacement of existing asset with a new asset.

UNIT:4 (10 Hours)

Overview of Indian financial system. Commercial bank, Functions of commercial bank, Credit creation, Central bank, Functions of Central Bank. Inflation Meaning of inflation, types, causes, measures to control inflation. National Income Definition, Concepts of national income, Method of measuring national income

Teaching Methods: Chalk& Board/ PPT

Text Books

1, Vengedasalam, Deviga. Madhavan, Karunagaran, Principles of Economics, Oxford University Press.
2. R. Paneer Seelvan, " Engineering Economics", PHI
3. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd
4. Riggs,J.L., Bedworth and Randhwa, "Engineering Economics", McGraw Hill

Education India
5.Paul, R.R., Money, Banking and International Trade, Kalyni Publishers.

Ref. Books
1.Park, Chan.S, "Fundamental of Engineering Economics", Pearson.
2. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
3. Thuesen, G.J.,Fabrycky,. Engineering Economy, PHI.
4.Jhingan,M.L., "Macro Economic Theory", Vrinda Publications Ltd

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC3110	**MECHANICS OF SOLIDS LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid

Course Educational Objectives

CEO1	Students will have the opportunity to apply loads to various materials under different equilibrium conditions
CEO2	The student will perform tests on materials in tension, compression, torsion, bending, and impact
CEO3	The machines and equipment used to determine experimental data include universal testing machines, torsion equipment, spring testing machine, compression testing machine, impact tester, hardness tester
CEO4	Data will be collected using Dial indicators, extensometers, strain gages and strain indicator equipment, as well as load and strain readouts on the machinery and graphing capabilities to print relevant plots for analysis
CEO5	Analysis of subsequent data obtained from the performed test and to present the results in a professionally prepared report

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Conduct tension, compression & bending test on UTM.
CO2	Perform impact & fatigue test of mild steel specimen.
CO3	Determine the Brinell, Rockwell and Vicker's hardness of different material.
CO4	Measure strain by using strain gauge and strain rosette.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				3									2	
CO2				2										
CO3				3									2	
CO4				2										
Avg.				2.5									1	

LIST OF EXPERIMENTS

LIST OF EXPERIMENT (Minimum 8 experiments)

1. Determination of tensile strength of materials by Universal Testing Machine
2. Determination of compressive strength of materials by Universal Testing Machine
3. Determination of bending strength of materials by Universal Testing Machine
4. Double shear test in Universal Testing Machine
5. Determination of Impact strength of material (Charpy and Izod)
6. Determination of Hardness strength of materials (Brinnel, Rockwell and Vickers)
7. Determination of Rigidity modulus of material
8. Determination of Fatigue strength of material
9. Estimation of Spring Constant under Tension and Compression.
10. Load measurement using Load indicator, Load Cells.
11. Strain measurement using Strain Gauge.
12. Stress measurement using strain rosette.

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR-765022

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC3120	**FLUID MECHANICS AND HYDRAULIC MACHINES** LABORATORY	**0**	**0**	**2**	**1**	

Pre -Requisite: Mathematics, Fluid Mechanics and Hydraulic Machines

Course Educational Objectives

CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Discuss the differences among measurement techniques, their relevance and applications.
CO2	Explain the condition of floating and submerging of any object in water.
CO3	Analyze the various parameters of flow through orifice, Notch and Venturimeter
CO4	Calculate the performance analysis of turbines and pumps that can be used in power plants.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			3										
CO2	2			3										
CO3	2			2										
CO4	2			3										
Avg	2.25			2.75										

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Determination of Metacentric Height and application to stability of floating bodies.
2. Determination of Cv and Cd of Orifices.
3. Experiments on impact of Jets
4. Experiments on performance of Pelton Turbine
5. Experiments on performance of Francis Turbine
6. Experiments on performance of Kaplan Turbine
7. Experiments on performance of centrifugal pump
8. Experiments on performance of reciprocating pump
9. Experiments on Reynold's Apparatus
10. Experiments on Flow through pipes

11. Verifications of Bernoulli's equation

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC3130	INTRODUCTION TO PHYSICAL METALLURGY & ENGG MATERIALS LABORATORY	0	0	2	1	

Pre -Requisite: Bonding in Solids, Grain, Crystal Structure, Packing Density

Course Educational Objectives

CEO1	Project an introductory view of the field of materials science within the framework of science and engineering disciplines.
CEO2	Provide a smooth link between the basic knowledge of science and
CEO3	Better prepare would-be materials engineers on ways to tackle day-to-day materials problems in professional engineering careers.
CEO4	Able to operate as effective engineers or scientists in metallurgical and materials industries or related fields.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Identify the branches of physical metallurgy and the causes of various types of crystal imperfections.
CO2	Understand the properties of materials and their applications based on the properties.
CO3	Classify steels and cast iron based on microstructure.
CO4	Evaluate the hardness and hardeneability of various treated and untreated steels.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				3									1	
CO2				3									3	
CO3				3									2	
CO4				3									2	
Avg				3									2	

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Preparation of crystal models SC, BCC, FCC,CPH crystals
2. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low Carbon steels, high Carbon steels.
4. Study of the Micro Structures of White cast iron, Grey Cast Irons, Malleable cast iron, Nodular cast iron etc.

5. Study of the Micro Structures of Non-Ferrous alloys Brass, Bronze, aluminum alloys.
6. Study of the Micro structures of Heat treated steels Annealed Normalized, Hardened.
7. Hardeneability of steels by Jominy End Quench Test.
8. To find out the hardness of various treated and untreated steels

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3151	JAVA PROGRAMMING LABORATORY	0	0	2	1	

Pre -Requisite: None

Course Educational Objectives

CEO1	To introduce the pure object-oriented concepts through Java programming.
CEO2	To enable a detailed insight into the Java programming concepts such as creating classes, Methods, Interfaces, Packages, Multithreaded Environment, String handling, Enumerations, Creating small Swing application.

Course Outcomes: Upon successful completion of this course, students should

CO1	Apply the object-oriented concepts through Java language.
CO2	Demonstrate the concepts of polymorphism and inheritance.
CO3	Write Java programs to implement error handling techniques using exception handling
CO4	Develop solution for a real problem using Java programming.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1											
CO2	3	3			2		1		1					
CO3	3	2			2							1		
CO4	3	3	3	2		1								
Avg	3	2.5	1	0.5	1	0.25	0.25		0.25			0.25		

LIST OF EXPERIMENTS

List of Experiment:

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3152	**DATABASE MANAGEMENT SYSTEMS LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: None

Course Educational Objectives

CEO1	Design and create a ERD (Entity Relationship Diagram) using software tool.
CEO2	Learn how to design and create and use a relational database system.

Course Outcomes: Upon successful completion of this course, students should

CO1	Implement the concept of Entity-Relationship (E-R) model from specified information and to transform into to relational model.
CO2	Apply the different types of Constraints in relational database and defines the database.
CO3	Compares the different types of manipulation and access methods of data from database.
CO4	Analyze and simple database application that demonstrates understanding of all the above, working as a team.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		2											
CO2	3		3											
CO3	2		2											
CO4	2		3											
Avg	2.5		2.5											

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Use of SQL syntax: insertion, deletion, join, updation using SQL.
2. Programs on join statements and SQL queries including where clause.
3. Programs on procedures and functions.
4. Programs on database triggers.
5. Programs on packages.
6. Programs on data recovery using check point technique.
7. Concurrency control problem using lock operations.
8. Programs on ODBC using either VC++.
9. Programs on JDBC.
10. Programs on embedded SQL using C / C++ as host language.

Additional Assignments

1. Use of NoSQL database like MongoDB.
2. Programs on connectivity to MongoDB using MEAN.

3. Programs on connectivity to Mongo-DB using Python.

IV SEMESTER [SECOND YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
7.	PC	BMEPC4010	Engineering Thermodynamics	3	0	0	3	A
8.	PC	BMEPC4020	Kinematics of Machinery	3	1	0	4	A
9.	PC	BMEPC4030	Basic Manufacturing Process	3	1	0	4	A
10.	PC	BMEPC4040	Mechanical Measurement & Metrology	3	0	0	3	A
11.	ES	BCSES3051	OOPS through JAVA	3	0	0	3	A
		BCSES3052	Database Management Systems					
12.	HS	BMSHS3061	Engineering Economics and Costing	3	0	0	3	A
		BBSBS3062	Environmental Engineering and Safety					
PRACTICAL								
5.	PC	BMEPC4110	Engineering Thermodynamics Laboratory	0	0	2	1	
6.	PC	BMEPC4120	Kinematics of Machinery Laboratory	0	0	2	1	
7.	PC	BMEPC4130	Basic Manufacturing Process Laboratory	0	0	2	1	

8.	ES	BCSES3151	JAVA Programming Lab	0	0	2	1	
		BCSES3152	Database Management Systems Laboratory					
TOTAL				**18**	**2**	**8**	**24**	

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC4010	ENGINEERING THERMODYNAMICS	3	1	0	3	A

Pre -Requisite: Fundamentals of Thermodynamics, Mathematics & Chemistry

Course Educational Objectives

CEO 1	Students will recall the basic principle of Thermodynamics & Understand the working principle of IC Engines, steam & Gas power plant, Refrigeration system and capable to analyze the parameters in various cycle etc.
CEO 2	Students will able to identify the methods to increase the efficiency of Air compressor, I c engines, Refrigeration system etc.
CEO 3	Students can analyze the availability for open and closed systems, Maxwell and TDS equation in ideal gases.
CEO 4	Students can capable to design pneumatic machinery components, IC engines, gas power plants as per the performance.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Illustrate Maxwell's and thermodynamic relations of gas mixtures, availability of flow and non flow systems, vapor and gas power cycles etc.
CO2	Identify the methods to increase the efficiency of vapor, gas and refrigeration cycles.
CO3	Estimate cooling load calculations for vapour compression refrigeration systems.
CO4	To design pneumatic machinery components as per the performance.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	3	3												
CO3	2	3												
CO4	1	3	2											
Avg.	2.25	2.75	0.5											

SYLLABUS

UNIT:1 Review of First and Second laws: [13 Hours]

First law analysis of unsteady flow control volumes, Entropy generation ,Entropy balance for closed systems and steady flow systems, Available energy, Quality of energy, Availability for non flow and flow process, Irreversibility, Exergy balance, Second law efficiency.

General Thermodynamic property relations:

Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations

UNIT:2 Vapour Power Cycles: [10 Hours]

The Carnot vapor cycle and its limitations, The Rankine cycle, Means of increasing the Rankine cycle efficiency, The reheat cycle, The regenerative feed heating cycle, Cogeneration (Back pressure and Pass-out turbines), Combined cycle power generation systems, Binary vapour cycles.

UNIT:3 Gas Power Cycles: [12 Hours]

Air standard cycles- Otto, Diesel, Dual Combustion and Brayton cycles, The Brayton cycle with non-isentropic flow in compressors and turbines, The Brayton cycle with regeneration, reheating and intercooling, Ideal jet propulsion cycle.

Refrigeration cycles:

Reversed Carnot cycle, Reversed Brayton cycle (Gas refrigeration system), The vapour compression cycle, The vapour absorption cycle.

UNIT:4 Reciprocating Air Compressors: [10 Hours]

Introduction (Uses of compressed air), The reciprocating cycle neglecting and considering clearance volume, Volumetric efficiency and its effect on compressor performance, Limitations of single stage compression, Multistage compression and intercooling, Optimum intercooler pressure, Performance and design calculations of reciprocating compressors, Air motors

Teaching Methods: Chalk& Talk, PPT, Video Lectures, Demonstrative models

Text Books:

1. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010.
2. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.
3. Nag.P.K., "Engineering Thermodynamics", 4thEdition, Tata McGraw-Hill, New Delhi, 2008.
4. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice-Hall of India Pvt. Ltd, 2006

Ref. Books:

1. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 1995.
2. Applied Thermodynamics by P.L.Ballaney, Khanna Publishers
3. Engineering Thermodynamics by Krieth, CRC Press
4. Steam Tables in SI Units by Ramalingam, Scitech

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC4020	KINEMATICS OF MACHINERY	3	1	0	4	A

Pre -Requisite: Basic of Mechanics (Statics) topics like: Equilibrium of forces, Free body diagram, friction and D'Alemberts principle

Course Educational Objectives

CEO 1	To obtain an idea of Mechanisms, basic of methodology of machines
CEO 2	Apply knowledge to the selection of proper techniques and processes for velocity and acceleration using graphical and analytical techniques
CEO 3	Basic knowledge of different types of Piston effort, force acting along the connecting rod, Crank effort, Turning moment on crank - shaft
CEO 4	Analyze and study of various types of clutches and pivots, dynamometers, Various gear trains and classification of brakes etc

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Recognize the basic of elements of mechanisms and describe, understand differentiate between mechanisms, solve for mobility with synthesis of mechanisms.
CO2	Apply the concept of mechanism to interpret and examine the velocity and acceleration of different linkages in mechanisms by analytical and graphical methods.
CO3	Analyze the effect of friction and estimate the loss of power due to friction between moving elements (i.e., Gears, clutches, brakes, belt drives etc...)
CO4	Propose for the engineering challenges regarding human needs in daily life about machines and systems which are possible due to the design of machines.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES	PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												1
CO2	2	3												2
CO3	2	2												2
CO4	2	3				1								1
Avg.	2.25	2.5				0.25								1.5

SYLLABUS

UNIT:1 (No of Hours.12)

Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double – Slider Chain.

VELOCITY ANALYSIS: Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Four Link Mechanism, Angular Velocity of Links, Velocity of Rubbing, Slider - Crank Mechanism, Crank and Slotted Lever Mechanism.

UNIT:2 (No of Hours10)

PLANE MOTION OF BODY : Instantaneous centre, Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method ACCELERATION ANALYSIS:

Acceleration, Four-Link Mechanism, , slider-Crank Mechanism Angular acceleration of Links, Acceleration of Intermediate and offset points, Coriolis acceleration component, Crank and slotted lever Mechanism.

UNIT:3 (No of Hours10)

KINEMATIC SYNTHESIS:

Stages of synthesis-Concepts of type, Number and dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein equation for function generation using three precision points.

Cams: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes, Graphical synthesis of cam profile

UNIT:4 (No of Hours12)

GEARS : Introduction, Classification gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth, Cycloidal Profile Teeth, Involute Profile Teeth, Path of contact, Arc of contact, Number of pairs of Teeth in contact, Interference in Involute Gears, Minimum number of Teeth, Interference between Rack and

Pinion, Undercutting, Comparison of Cycloidal and Involute tooth forms. **GEAR TRAINS:** Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains. Tabular and Algebraic Methods
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert
Text Books 1. Theory of Machines /S.S.Rattan – Tata McGraw Hill Publishers. 2. Theory of Mechanisms and Machines by Ghosh and Mallik
Ref. Books 1. Theory of Machines / R. S. Khurmi and J K Gupta /S.Chand 2. Theory of Machines / Sadhu Singh / Pearson. 3. Theory of Machines / Shigley / Oxford

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC4030	BASICS MANUFACTURING PROCESS	3	1	0	4	A
Pre -Requisite: Metallurgy						
Course Educational Objectives						
CEO 1	To study basic definitions associated with casting terminology, its classification and various steps involved in it.					
CEO 2	To understand the application of the different joining techniques, and be able to select an appropriate technique according to a specific requirement.					
CEO 3	To understand the fundamentals of metal working process.					
CEO 4	To give the basic concept of the powder metallurgy processing and also the theory and technology of powder production, consolidation and sintering.					
CEO 5	To understand plastic manufacturing operations including product development, plastics processing, equipment selection, tooling selection.:					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Select materials, types and allowances of patterns used in casting and analyze the components of moulds.					

CO2	Design core, core print and gating system in metal casting processes
CO3	Compared and contrast arc, gas, solid state and resistance welding processes.
CO4	Develop process for metal forming processes using plasticity principles

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1											2	
CO2	1	2	2										1	
CO3	3	2											2	1
CO4	2	2											1	
Avg.	2.25	1.75	0.5										1.5	0.25

SYLLABUS

UNIT:1 [10 Hours]

Metal Casting Processes: sand mold making procedure. Patterns: Pattern materials, pattern allowances, types of pattern, color coding. Molding materials: Molding sand composition, sand preparation, sand properties and testing, Sand molding processes. Cores: Types of cores, core prints, chaplets, and chills. Design of Gating systems: Melting practice: Cupola furnace, solidification, defects in castings and their remedies, Shell molding, precision investment casting, permanent mold casting, die casting, centrifugal casting, continuous casting, Advantages and limitations.

UNIT:2 [10 Hours]

Welding Process: Principles of welding, brazing and soldering, Classification of Welding Processes, gas welding and cutting process, equipment. Arc welding power source and consumables. Resistance welding: Principle and equipments, resistance spot welding, resistance seam welding, electro slag welding, forge welding. Modern welding methods like plasma arc, laser beam, Electron beam, Ultrasonic, Explosive and friction welding. Destructive and Non destructive testing of casting and welding.

UNIT:3 [12 Hours]

Metal Forming Processes:

Nature of plastic deformation, hot working and cold working .Principles of rolling, roll passes, roll pass sequences. Forging: Forging operations, smith forging, drop forging, press forging, forging defects.

Extrusion and Sheet metal operations:

Extrusion principle, hot extrusion, cold extrusion, wire drawing, swaging, tube making. Sheet metal operations: Press tools operations, shearing action, drawing dies, spinning, bending, stretch forming, embossing and coining.

UNIT:4 [10 Hours]

Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of Powder Metallurgy. Brief introduction to explosive

forming, coating and deposition methods. Plastics: Introduction, Raw material for plastics, Properties of plastics, types, Thermosetting plastics, Thermoplastics, Moulding compounds.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert
Text Books: 1. Manufacturing Technology-Foundry, Forming and Welding - P.N. Rao, Tata McGraw Hill, 2. Manufacturing Science - Ghosh A; Mallik A.K. Affiliated East-West Press Pvt. Ltd., New Delhi
Ref. Books: 1. Foundry Technology - K.P. Sinha, D.B. Goel, Roorkee Publishing House. 2. Welding and Welding Technology - Richard L. Little Tata McGraw Hill Ltd. 3. Principle of Metal casting - Rosenthal, Tata McGraw Hill, New Delhi

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC4040	**MECHANICAL MEASUREMENT & METROLOGY**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Physics, fluid mechanics						
Course Educational Objectives						
CEO 1	To develop in students the knowledge of basics of Measurements, Metrology and Measuring devices.					
CEO 2	To understand the concepts of various measurement systems & standards with regards to realistic applications.					
CEO 3	The application of principle of metrology and measurements in industries.					

CEO 4	To develop competence in sensors, transducers and terminating devises with associated parameters
CEO 5	To develop basic principles and devices involved in measuring surface textures.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Recognize the concept of measurement and identify the errors involved in the measurement.
CO2	Explain the different types of sensors, strain gauge and circuits used in measurement systems.
CO3	Interpret measurement of field variables like force, torque, pressure, temperature,flow,vibration and noise to explain data acquisition system.
CO4	Discuss the metrology concept and demonstrate the different measuring instruments,sampling and inspections.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												
CO2	3	2												
CO3	2	3												
CO4	3	1												
Avg.	2.75	2.25												

SYLLABUS

UNIT:1 [10 Hours]

Definition and methods of measurement, classification of measuring instruments, Measuring systems, performance characteristics of measuring devices, types of errors. Functional elements of measuring system. Static and Dynamic Characteristics of Instruments: Static Performance Parameters, Impedance Loading and Matching, Selection and Specifications of Instruments, Dynamic Response, Compensation.

UNIT:2 [10 Hours]

Transducer Elements: Analog Transducers, Digital Transducers, Basic detector transducer elements: Electrical transducer, Sliding Contract devices, Variable-inductance transducer elements, the differential transformer, Variable-reluctance transducers, Capacitive transducers. The piezoelectric effect, photo-electric transducer, electronic transducer element.

Intermediate Elements: Amplifier, Operational Amplifier, Differential and Integrating Elements, Filters, A-D and D-A Converters

UNIT:3 [16 Hours]

Strain Measurement

The electrical resistance strain gauge. The metallic resistance strain gauge, Selection and Installation factors for metallic strain gauge, Circuitry, metallic strain gauge. The strain

gauge ballast circuit, the staring gauge bridge circuit, Temperature compensation. Measurement of Pressure Pressure measurement systems, Pressure measurement transducers, Elastic diaphragms, strain gauge pressure cells, measurement of high pressure, Measurement of low pressures, dynamic characteristics of pressure measuring systems. Measurement of Fluid Flow characteristics obstruction meters, Obstruction meter for compressible fluids- Orifice, Venturi meter and Pitot tube, The variable-area meter, Turbine Flow meters. Temperature Measurement Use of bimetals pressure thermometers, Thermocouples, Pyrometry, Calibration of temperature measuring devices.Force, Power, Speed and Torque Measurement : Load Cell, Dynamometers, Tachometer and Tacho-generator, Stroboscope, The seismic instrument.- Vibrometers and accelerometers.
UNIT:4 [10 Hours] Principles of Measurements, Line and End & optical Standards, Calibration, accuracy and Precision, Random error and systemic error. Measurement of Surface Roughness, Screw Thread and Gears. Limits, Fits and Gauges, Assembly by full, partial and group interchangeability, geometric tolerances. Measurement of straightness, Flatness and circularity.
Teaching Methods: Chalk& Board/ PPT
Text Books: 1. Engineering Metrology & Measurement, N.V.Raghavendra and L. Krishnamurthy, OXFORD University Press 2. Instrumentation Measurement and Analysis, B.C.Nakra and KK.Chaudhry, Tata Mc Graw
Ref. Books: 1. Metrology & Measurement, A. K. Bewoor and V.A.Kulkarni, Mc Graw hill 2. Mechanical Measurements, T.G. Beckwith and N. Lewis Buck, Oxford and IBH Publishing Co. 3. Engineering Metrology,R.K. Jain, Khanna Publisher, Delhi 4. Mechanical measurements and Instrumentation and control A.K Sawhney and Puneet Sawhney,Dhanpat Raj & Co

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BCSES3051	OOPS THROUGH JAVA	3	0	0	3	A
Pre -Requisite:						

Course Educational Objectives	
CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using java doc.
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Ability to analyze ,formulate and model problems using concepts of object oriented analysis and design and implement using Java and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Analyze the problems and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Realize the power of generics and Collections Framework and Java.io package

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	3	2	2											
CO3	2	2	2											
CO4	2	1	2											
Avg.	2.5	1.5	1.5											

SYLLABUS

UNIT:1 (12 Hours)

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Data types, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

UNIT:2 (14 Hours) Introduction to Classes and Objects. Constructors, static Keyword, this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance, Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.
UNIT:3 (14 Hours) Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class. IO Streams (java.io package) , Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map.
UNIT:4 (14 Hours) Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1 Programming in Java. Second Edition. Oxford Higher Education. (Sachin Malhotra/ Saurav Choudhary) 2 Core Java For Beginners. (Rashmi Kanta Das), Vikas Publication
Ref. Books 1. JAVA Complete Reference (9th Edition) Herbalt Schelidt

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3052	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	A

Pre -Requisite:

Course Educational Objectives

CEO1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.
CEO2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
CEO3	Understand the use of Structured Query Language (SQL) and its syntax
CEO4	Apply Normalization techniques to normalize a database.
CEO5	Understand the need of Database processing and learn techniques for controlling the consequences of concurrent data access.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Identify and Classify the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	Apply the constraints in database using different query languages like:- relational algebra and calculus, SQL and QBE for the implementing the Data definition and data manipulate languages in Database.
CO3	Compare the different normal forms to Apply normalization process to construct the consistent Database.
CO4	Design and Develop the Database by inspecting concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	3	2												
CO3	2	2												
CO4	2	1												
Avg.	2.5	1.5												

SYLLABUS

UNIT:1 (15 Hours)

Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database

Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.
UNIT:2 (13 Hours) Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.
UNIT:3 (10 Hours) Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.
UNIT:4 (12 Hours) Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques, fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1 Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education 2. Elmasari &Navathe: Fundamentals of Database System, Pearson Education.
References Books: 1. Elmasari &Navathe: Fundamentals of Database System, Pearson Education. 2. Ramakrishnan: Database Management Systems, McGraw-Hill Education. 3. Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.

4. Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly Media

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS3062	ENVIRONMENTAL ENGINEERING & SAFETY	3	0	0	3	A

Pre -Requisite:

Course Educational Objectives

CEO 1	The course introduces the students to the environmental consequences of industries
CEO 2	To provide minimization of their impacts through technology and legal systems.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the ecological system of environment.
CO2	Learn about treatment of water/waste water
CO3	Discuss on the causes and remedies of environment pollution and technological approaches.
CO4	Elaborate the importance of environmental safety.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2		3	2	1										
CO3					2		3							
CO4					2		3							

Avg.	0.5	1	0.5	0.25	1		1.5							

SYLLABUS

UNIT:1 (10 Hours)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre treatment of water, Conventional process, Advanced water treatment process.

UNIT:2 (12 Hours)

Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion ,Reactor configurations and methane production. Air Pollution: Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change – greenhouse gases, non criteria pollutants, Air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

UNIT:3 (10 Hours)

Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing.

UNIT:4 (10 Hours)

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention Detection, Extinguishing Fire, Safety Management Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydro Carbons Wastes. Personal Protective Equipments.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Book

1. Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely.
2. Environmental Engineering,, Nelson L NEMEROW, Franklin J,AGARDY, Patrick SULLIYAN and Joseph A. SALVATO.
3. Environmental Science and ethics, Smriti Srivastava, S.K Kataria and Sons publishers

Ref. Books

1. Environmental Engineering by Arcadio P. Sincero &Gergoria A Sincero PHI Publication.
2. Environmental Science, Curringham & Saigo, TMH

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMSHS3061	**ENGINEERING ECONOMICS & COSTING**	**3**	**0**	**0**	**3**	**A**
Pre Requisite: None						
Course Educational Objectives						
CEO 1	To understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost					
CEO 2	To help students to grasp various economics concepts and theories towards making economic decision.					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Understanding the fundamentals of economic theory in general concept of demand & supply, theories of production Laws of returns					
CO2	Overview of cost and revenue concepts: Understood the nature and behaviour of cost, cost sheet, Break even analysis linear approach and understanding of depreciation with its measurement.					
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time value of Money, Determination of					

	economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						1					2	2		
CO2						1					3	1		
CO3						1					3	2		
CO4						2					3	1		
CO5						2					3	2		
Avg.						1.4					2.8	1.6		

SYLLABUS

UNIT:1
(12 Hours)
Engineering Economics –Meaning, Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.Demand and Supply Analysis Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).
Theory of Production Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2
(10 Hours)
Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis Linear approach (Simple numerical problems to be solved). Depreciation Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT:3

(12 Hours) Time value of money Interest Analysis Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence. Evaluation of engineering projects Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Sensitivity Analysis, Replacement Analysis Determination of economic life of an asset, Replacement of existing asset with a new asset.
UNIT:4 (10 Hours) Overview of Indian financial system. Commercial bank, Functions of commercial bank, Credit creation, Central bank, Functions of Central Bank. Inflation Meaning of inflation, types, causes, measures to control inflation. National Income Definition, Concepts of national income, Method of measuring national income
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 1, Vengedasalam, Deviga. Madhavan, Karunagaran, Principles of Economics, Oxford University Press. 2. R. Paneer Seelvan, " Engineering Economics", PHI 3. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd 4. Riggs,J.L., Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India 5.Paul, R.R., Money, Banking and International Trade, Kalyni Publishers.
Ref. Books 1.Park, Chan.S, "Fundamental of Engineering Economics", Pearson. 2. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson 3. Thuesen, G.J.,Fabrycky,. Engineering Economy, PHI. 4.Jhingan,M.L., "Macro Economic Theory", Vrinda Publications Ltd

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC4110	ENGINEERING THERMODYNAMICS LABORATORY			2	1	

Pre -Requisite: Thermodynamics

Course Educational Objectives

CEO1	Students will recall the basic principle of Thermodynamics and Understand the working principle of IC Engines, steam & Gas power plant, Refrigeration system etc.
CEO2	Students will able to identify the methods to increase the efficiency of Air compressor and gear oil pump
CEO3	Students can estimate steam quality calculations using calorimeter and joule Thomson coefficient
CEO4	Students can capable to design pneumatic machinery components, IC engines, calorimeter as per the performance

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Recall the basic principle of Thermodynamics and Understand the working principle of IC Engines, steam & Gas power plant, Refrigeration system.
CO2	Identify the methods to increase the efficiency of Air compressor and gear oil pump.
CO3	Estimate steam quality calculations using calorimeter and joule Thomson coefficient etc.
CO4	Design pneumatic machinery components, IC engines, calorimeter as per the performance.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	1	1	1	3
CO1	3			3										
CO2	2			3								2		
CO3			1	3										
CO4			3	3								3		
Avg	1.2		1	3								1		

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)
1. Study of Cut-Sections of 2 stroke and 4 stroke Diesel Engine.
2. Study of Cut-Sections of 2 stroke and 4 stroke Petrol Engine.
3. Study of steam power plant.
4. Study of refrigeration system.
5. Study of gas turbine power plant.
6. Performance analysis of Reciprocating air-compressor.
7. Performance analysis of Centrifugal / Axial Flow compressor.
8. Determination of performance characteristics of gear pump.

9. Measurement of steam quality using calorimeter
10. Verification of Joule-Thomson coefficient.

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC4120	KINEMATICS OF MACHINERY LABORATORY	0	0	2	1	

Pre Requisite: Physics , Mechanics, Theory of Machine

Course Educational Objectives

CEO1	To understand the concept of machines, mechanisms and elated terminologies
CEO2	Discriminate mobility (number of degrees-of-freedom). Enumeration of rigid links and types of joints within mechanisms. To make the students become familiar and understanding of the most commonly used mechanisms (4-bar, 6-bar linkages, and cams).
CEO3	To understand the Principles and working of various straight line motion mechanisms
CEO4	To develop and analyze cam profiles for different mechanisms.

Course Outcomes: *Upon successful completion of this course, students should*

CO1	Develop the design concepts of different types of mechanism with lower pairs and higher pairs
CO2	Analyze the velocity and acceleration of links of different mechanisms.
CO3	Study and analyze the gear profiles and gear trains.
CO4	Synthesis of the different mechanisms

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2										
CO2				2										
CO3	1			2										
CO4			2	2										
Avg	0.5		0.5	2										

LIST OF EXPERIMENTS

List Of Experiments: (Minimum 8 Experiments)

1. Design of any one working model related to Kinematics of Mechanisms i.e., unit I and unit II.
2. Radius of Gyration of compound pendulum
3. Radius of Gyration of Connecting Rod.
3. Study of simple /compound/Reverted Gear trains
4. Experiment on Cam Analysis Apparatus.
5. Experiment on Coriolis component of acceleration.
7.Experiment on Journal Bearing Apparatus
8. Study of interference and undercutting for gear drives.
9.Experiment on Epicyclic gear train

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR-765022

Approved by AICTE, Govt. of Odisha and Affiliated to BPUT, Rourkela, Odisha
Accredited by NAAC with a CGPA of 3.28/4 at *A Grade* and Accredited by NBA
Dist. - Rayagada, Odisha, INDIA www.giet.edu

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC4130	**BASIC MANUFACTURING PROCESS LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite:

Course Educational Objectives

CEO1	Examine the principles associated with basic operations involving the casting ,forming and welding of engineering materials
CEO2	Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component
CEO3	To know the basic processes used in performing forming and welding operations on engineering materials
CEO4	Formulate practical design methods to materials working techniques

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Test the properties of moulding sands.
CO2	Fabricate joints using TIG, MIG, Brazing and soldering
CO3	Develop process maps for metal forming processes using plasticity principles.
CO4	Estimate formability limits for sheets and bulk metals

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				3									1	
CO2				3										2
CO3				2									2	
CO4				2									1	
Avg				2.5									1	0.5

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1.Determination of grain size, clay content, permeability and green compressive strength of Molding sand. (2 to 3 experiments)

2.Foundry Practices

3. Preparation of a wood pattern.

4.Determination of strength of brazed and solder joints

5.Practice and preparation of job in TIG/MIG welding

6. Practice and preparation of job in sheet metal using processes like forming and deep drawing.

7.Demonstration of different rolling mills

8.Demonstration of Extrusion processes

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3151	**JAVA PROGRAMMING LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: None

Course Educational Objectives

CEO1	To introduce the pure object-oriented concepts through Java programming.
CEO2	To enable a detailed insight into the Java programming concepts such as creating classes, Methods, Interfaces, Packages, Multithreaded Environment, String handling, Enumerations, Creating small Swing application.

Course Outcomes: Upon successful completion of this course, students should

CO1	Apply the object-oriented concepts through Java language.
CO2	Demonstrate the concepts of polymorphism and inheritance.
CO3	Write Java programs to implement error handling techniques using exception handling
CO4	Develop solution for a real problem using Java programming.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1											
CO2	3	3			2		1		1					
CO3	3	2			2							1		
CO4	3	3	3	2		1								
Avg	3	2.5	1	0.5	1	0.25	0.25		0.25			0.25		

LIST OF EXPERIMENTS

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BCSES3152	DATABASE MANAGEMENT SYSTEM LABORATORY	0	0	2	1	

Pre -Requisite: None

Course Educational Objectives

CEO1	Design and create a ERD (Entity Relationship Diagram) using software tool.
CEO2	Learn how to design and create and use a relational database system.

Course Outcomes: Upon successful completion of this course, students should

CO1	*Implement* the concept of Entity-Relationship (E-R) model from specified information and to transform into to relational model.
CO2	*Apply* the different types of Constraints in relational database and defines the database.
CO3	*Compares* the different types of manipulation and access methods of data from database.
CO4	*Analyze* and simple database application that demonstrates understanding of all the above, working as a team.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	1	1	1	2
CO1	3	3	2		2									
CO2	3	3	3	2	2									
CO3	3	3	3											
CO4	3	3	3	2	2				3	2				
Avg	3	3	2.7	1	1.5				0.7	0.5				

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Use of SQL syntax: insertion, deletion, join, updation using SQL.
2. Programs on join statements and SQL queries including where clause.
3. Programs on procedures and functions.
4. Programs on database triggers.
5. Programs on packages.
6. Programs on data recovery using check point technique.
7. Concurrency control problem using lock operations.
8. Programs on ODBC using either VC++.
9. Programs on JDBC.
10. Programs on embedded SQL using C / C++ as host language.

Additional Assignments

1. Use of NoSQL database like MongoDB.
2. Programs on connectivity to MongoDB using MEAN.
3. Programs on connectivity to Mongo-DB using Python.
4. Programs on connectivity to MongoDB using PHP.

V SEMESTER [THIRD YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC5010	Internal Combustion Engines	3	1	0	4	A
2	PC	BMEPC5020	Machining Science & Technology	3	0	0	3	A
3	PC	BMEPC5030	Design of Machine Elements	3	0	0	3	A
4	PC	BMEPC5040	Dynamics of Machinery	3	0	0	3	A
5	OE	B**OE5051 B**OE5052 B**OE5053 B**OE5054	Open Elective-1 (Any one)	3	0	0	3	A
6	BS/ HS	BBSBS5061 BMSHS5062	Optimization in Engineering Organizational Behaviour	3	0	0	3	A
PRACTICAL / SESSIONAL								
7	PC	BMEPC5110	Internal Combustion Engines Laboratory	0	0	2	1	
8	PC	BMEPC5120	Machining Science & Technology Laboratory	0	0	2	1	
9	PC	BMEPC5130	Design of Machine Elements Laboratory	0	0	2	1	
10	PC	BMEPC5140	Dynamics of Machinery Laboratory	0	0	2	1	
11	PC	BMEPC5150	*Skill Development Project and Hands on Training	0	0	2	1	
12	PC	BMEPC5170	^Summer Internship-I	0	0	2	1	
		TOTAL:		**18**	**1**	**12**	**25**	

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC 5010	INTERNAL COMBUSTION ENGINES	3	1	0	4	A

Pre requisite: Basic thermodynamic & mathematics

Course Educational Objectives

CEO 1	Understand the thermodynamic cycle(Otto, Diesel) and know the working principle of reciprocating internal combustion engine.
CEO 2	Understand the concept of atomization of fuel in carburetor and spray formation in injector.
CEO 3	Understand the mechanism of ignition, injection, combustion, supercharging, scavenging ,knocking and detonation phenomena.
CEO 4	Understand the engine performance in terms of power, efficiency, exhaust emission and control.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Illustrate working and performance of IC Engines through thermodynamic cycles, and various systems of IC engine.
CO2	Classify atomization ,spray formation and combustion phenomena related to SI and CI engines and factors influencing combustion chamber design.
CO3	Analyze exhaust gas emission formation mechanism of IC engines and its effects and the legislation standards.
CO4	Design IC Engine with use of super charger and turbo charger according to alternate fuels.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												1
CO2	3	2												1
CO3	3	3												1
CO4	1	2	2											1
Avg.	2.5	2.5	0.5											1

SYLLABUS

UNIT:1 [10 Hours]

Introduction, Classification of I.C. Engines. Fundamental difference between SI and CI engines, Comparison of two stroke and four stroke engines. Valve timing diagram, Properties and rating of IC engine, fuels, Additives and non-petroleum

fuels.
Introduction to Alternative Fuels: LPG, LNG, CNG, Alcohol, Hydrogen, Vegetable oils and Biogas.

UNIT:2 [14 Hours]

Carburetion and Fuel injection: Function of carburetors, Description and principle of simple carburettor and its drawback, petrol injections. Requirements of diesel injections system. Types of injection systems, Fuel pumps and nozzles, types of fuel injections, Spray formation, penetration and direction. Combustion of Fuels: Stages of SI engine combustion, Effect of engine variables on ignition lag and flame propagation, fuel knock, control of knock. SI engine combustion chamber stage of diesel combustion, variables affecting delay period. Diesel knock and methods of control. CI engine combustion chambers

UNIT:3 [10 Hours]

Supercharging and scavenging: Thermodynamic cycle with supercharging and its effect. Efficiency of supercharging engines Methods of supercharging and scavenging of two stoke engines. Turbo charging: Methods of turbo charging, effects of turbo charging on performance

UNIT:4 [12 Hours]

Testing and Performance: Fuel air and power measurement methods. Performance of SI and CI engines, Characteristic curves, Governing of speed. Engine Emission and Control:
Engine Emissions and its harmful effects. Gasoline and Diesel emission. Methods of measuring pollutants controlling of engine emission. Cooling Lubrication and ignition systems: Air cooling and water cooling systems effects of cooling on power output and efficiency. Properties of lubricants additives lubricating systems. Battery, Magnet ignition systems ignition timing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books:

2. IC Engines, V Ganeshan, TMH, 4th edition (2014)
3. IC Engines, H N Gupta, PHI Publication 2nd edition (2002)

Ref. Books:

9. IC Engines, Mathur and Sharma, Dhanpat Rai & Sons 2nd Edition (2008)
10. IC Engines, Gill and Smith, OXFORD & IBH 2nd Edition (2007)
11. IC Engines Fundamentals, John B. Heywood, TMH 2nd edition (2012)

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC5020	**MACHINING SCIENCE AND TECHNOLOGY**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Engineering workshop, Mechanics, Basics of Mathematics, Basics of Physical metallurgy

Course Educational Objectives

CEO 1	To know the basics of metal machining and mechanics of metal machining
CEO 2	To study the different cutting tool materials and types & geometry of cutting tools
CEO 3	To acquire knowledge on various machining processes and its working principle
CEO 4	To select the best suitable non conventional manufacturing process for processing of various hard, brittle and heat sensitive materials employed in modern manufacturing industries.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Illustrate ASA and ORS systems of tool geometry and their inter-relations.
CO2	Develop relations for chip reduction coefficient, shear angle, shear strain, forces, power, specific energy and temperature in orthogonal cutting
CO3	Explain working of lathe, shaper, planer, drilling, milling and grinding machines and need of non conventional machining process.
CO4	Evaluate process parameter to minimize production cost and maximize production rate.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2	2	2												

CO3	3	2												2
CO4	2	3												
Avg.	2.25	2												0.5

SYLLABUS

UNIT:1 [12 Hours]

Classification of various tool and tool geometry, various tool angles of a single point cutting tool, ASA and ORS, Conversion of ASA to ORS and vice versa, Mechanics of chip formation, Effect of Geometrical parameters on cutting force and surface finish, Merchant's theory, Force relationship and velocity relationship, Cutting tool materials, Types of Tool Wear: Flank wear, Crater wear, Wear measurement, Cutting fluid and its effect; Machinability Criteria, Tool life and Taylor's equation, Effect of variables on tool life and surface finish..

UNIT:2 [14 Hours]

Conventional machining process and machine tools – Turning, Drilling, Shaping, Planning, Milling, Grinding. Machine tools used for these processes, their specifications and various techniques used. Principles of machine tools : Kinematics of machine tools, speed transmission from motor to spindle , speed reversal mechanism, mechanism for feed motion, Tool holding and job holding methods in different Machine tools, Types of surface generated, Indexing mechanism and thread cutting mechanism, Quick return mechanism..

UNIT:3 [12 Hours]

Production Machine tools – Capstan and turret lathes, single spindle and multi spindle semiautomatics, Gear shaper and Gear hobbing machines, Copying lathe and transfer machine, Calculation of Machining time for various machining process, Economics of machining.

UNIT:4 [10 Hours]

Non-traditional Machining processes: Need of non-conventional machining, Comparison of conventional and non-conventional machining, Working principle of Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Electro Chemical Machining, Electro Discharge Machining, Wire EDM, Abrasive Jet Machining, Application, Advantage and limitation of various non conventional machining processes.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books:

3. Fundamentals of Machining and Machine Tools, G.Boothroyd and W.A.Knight, CRC Press
4. Metal Cutting Principles, M.C.Shaw, Oxford University Press

Ref. Books:

1. Manufacturing Technology – by P.N.Rao, Tata McGraw Hill publication.
2. Modern Manufacturing Processes, P.C.Pandey, H.S.Shan, Tata McGraw Hill
3. Manufacturing Science, Ghosh and Mallik, East West Press.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC5030	**DESIGN OF MACHINE ELEMENTS**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Mathematics, Mechanics of Solid

Course Educational Objectives

CEO1	To teach students how to apply the concepts of stress analysis, theories of failure and able to do tolerance analysis and specify appropriate tolerances for machine design applications by using data book.
CEO2	To analyze and design structural joints.
CEO3	To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems
CEO4	To analyze and design mechanical springs.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Learn the basic concepts of mechanical engineering design.
CO2	Demonstrate the design of mechanical joints
CO3	Develope the design of keys and coupling s.
CO4	Explain the stress analysis and various types of springs.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2											1
CO2	2	3	2											1
CO3	2	1	2											
CO4	1	1	3											1

Avg.	1.75	2	2.25											0.75

SYLLABUS

UNIT:1 [16 Hours]

Mechanical engineering design: Introduction to design procedure, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Use of Data books.Fundamentals of Machine Design: Types of load, Modes of failure, factor of safety concepts, Theories of Failure, concept and mitigation of stress concentration, Fatigue failure and curve, endurance limit and factors affecting it, Notch sensitivity, Goodman, Gerber and Soderberg criteria

UNIT:2 [12 Hours]

Machine Element Design: Design of Joints: Rivets, welds based on different types of loading, Boiler joints, cotter joints and knuckle joints

UNIT:3 [12 Hours]

Design of Keys, Shaft and Couplings: Classification of keys and pins, Design of keys and pins, Design of shafts: based on strength, torsional rigidity and fluctuating load.

Design of couplings: Rigid coupling-muff ,split muff and flange coupling , Flexible coupling

UNIT:4 [10 Hours]

MECHANICAL SPRINGS: Stresses and deflections of helical springs – extension - compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
2. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett,TMH

Ref. Books:

1. Machine Design, P.Kanaiah, Scietech Publications
2. Fundamentals of Machine Component Design by R.C.Juvinall and K.M.Marshek, JohnWiley & Sons
3. Machine Drawing by N.Sidheswar, McGraw-Hill

Subject Code	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC5040	**DYNAMICS OF MACHINERY**	**3**	**0**	**0**	**3**	**B**
Pre -Requisite: Basic Mathematics, Physics , Mechanics						
Course Educational Objectives						
CEO 1	To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations					
CEO 2	Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses					
CEO 3	Develop understanding of vibrations and its significance on engineering design.					
CEO 4	Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Classify the steering mechanisms and gyroscopic effects on various dynamic objects.					
CO2	Develop a cam profile to meet desired needs within realistic constraints, calculate the inertia forces in reciprocating and rotating masses along with turning moments in flywheels.					

CO3	Analyze static and dynamic balancing of rotating and reciprocating masses, classify the various kinds of governors, recognize the effect of controlling force.
CO4	Analyze the effect of vibration in desired systems; determine the natural frequency of a vibration system.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	3	3	1											
CO3	2	2												2
CO4	3	3												1
Avg.	2.75	2.5	0.25											0.75

SYLLABUS

UNIT:1 (12 Hours)

Dynamic Force Analysis : Introduction, D'Alembert's Principle, Equivalent Offset Inertia Force, Dynamic Analysis of Slider - Crank mechanism (Using Analytical method) Velocity and Acceleration of piston, Angular velocity and Angular Acceleration of Connecting Rod, Piston Effort (Effective Driving Force), Crank Effort, Turning moment diagram –fluctuation of energy.

Mechanisms with lower pairs: Motor Vehicle Steering Gears - Davis Steering Gear & Ackermann Steering Gear, Hooke's Joint.

UNIT:2 (12 Hours)

Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.

UNIT:3 (10 Hours)

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis. Clutches – Types – Single plate, multi-plate and cone clutches.

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation

UNIT:4 (16 Hours)

Balancing : Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples.

Examination of "V" and multi cylinder in-line and radial engines for primary and

secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort. Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations –Free vibrations with viscous damping, Logarithmic Decrement.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 1. Theory of Machines, S.S.Rattan. 2. Theory of Machines, R.K.Bansal (Lakshmi publications)
Ref. Books 1. Theory of Machines, Shigley, Mc Graw Hill Publishers 2. Theory of Machines, Thomas Bevan, CBS Publishers 3. Theory of Machines, R.S.Khurmi

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS5061	**OPTIMIZATION IN ENGINEERING**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Basics of Mathematics, matrix, partial differential equation addition of linear equations						
Course Educational Objectives						
CEO1	To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science					
CEO2	To provide students with opportunity using various software package for solving liner programming and integer programming models					
CEO3	To introduce the students to use of basic methodology for solution of linear programs and integer programs					

CEO4	To introduce the students to advance methods for large scale transportation and assignment problems
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Analyze, formulate and solve linear programming problems using appropriate techniques.
CO2	Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship
CO3	Develop mathematical skills to analyze and solve integer programming problem arising from a wide range of applications.
CO4	Communicate ideas, explain procedures and interpret results and solutions

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												
CO2	3	3												
CO3	3	2												
CO4		3												
Avg.	2.25	2.75												

SYLLABUS

UNIT:1 [14 Hours]

Introduction Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, Big-M method, duality theory, primal-dual relationships, sensitivity analysis.

UNIT:2 [14 Hours]

Transportation and Assignment Problems Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems. Integer programming: Special features, binary integer programming models-branch-and-bound technique.

UNIT:3 [10 Hours]

Dynamic Programming Characteristics, principle of optimality, solution procedure, deterministic problems. Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.

UNIT:4 [10 Hours]

Non-linear programming Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained

optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.
Teaching Methods: Chalk& Board/PPT
Text Books: 1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book 2.KantiSwarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7thEdition, Sultan chand& Sons, New Delhi, 2005
Ref. Books: 1. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd 2. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7thEdition, TMH, 2009. 3. Kalyanmoy Deb, "Optimization for Engineering Design", PHI Learning Pvt Ltd

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BMSHS5062	ORGANISATIONAL BEHAVIOUR	3	0	0	3	A
Pre -Requisite:						
Course Educational Objectives						
CEO1	To develop an understanding of the behaviour of individuals and groups inside					

	organizations
CEO2	To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
CEO3	To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Define, explain and illustrate a range of organizational behaviour theories.
CO2	Analyse the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts.
CO3	Explain about organisational culture. How organisational culture plays important role towards organisational success
CO4	Communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and thetorical conventions about organisational changes

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3		2	1					
CO2						2		2	2					
CO3						1		1	2					
CO4						1		1	3					
Avg.						1.75		1.5	2					

SYLLABUS

Unit – I [10Hrs]

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive), Limitations of OB.

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behaviour and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Unit - II [7Hrs] Foundations of Group Behaviour: The Meaning of Group & Group behaviour & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development. Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building. Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.
Unit – III [6 Hrs.] Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.
Unit – IV [8 Hrs.] Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change. Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 1. Understanding Organizational Behaviour, Parek, Oxford 2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
Reference books: 1. Organizational Behaviour, K. Awathappa,HPH. 2. Organizational Behaviour, VSP Rao, Excel 3. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage. Organizational Behaviour, Hitt, Miller, Colella, Wiley

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC 5110	**INTERNAL COMBUSTION ENGINE LABORATORY**	**0**	**0**	**2**	**1**	
Pre -Requisite: Basic Knowledge of Thermodynamic cycle and Mathematics						

Course Educational Objectives	
CEO1	Understand thermodynamic cycle, valve timing diagram, function of different components and its working principle.
CEO2	Understand the mechanism of carburetion, injection and know the working principle of carburetor, injector, fuel pump, air filter.
CEO3	Understand different types of cooling system, lubrication, analysis of exhaust gas emission.
CEO4	Understand load test analysis, performance analysis of single cylinder/ multi cylinder SI and CI engine.
Course Outcomes: Upon successful completion of this course, students should	
CO1	Classify the concept of valve timing diagram of both SI and CI engine.
CO2	Develop the concept of carburetion, atomization, spray formation and injection technique.
CO3	Compare lubrication and cooling phenomena related to SI and CI engines and factor influencing them.
CO4	Measure load test analysis and prepare heat balance sheet on four stroke multi cylinder SI and CI engine.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			2										1
CO2	1			3										2
CO3	1			2										1
CO4	1			2										2
Avg	1.25			2.25										1.5

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Valve timing diagram of an IC engine
2. Study of a modern carburetor (e.g. Solex Carburtor)
3. Study of fuel injection system of a diesel engine
4. Analysis of exhaust gas of automobile
5. Study of different cooling systems in automobiles (Air cooling and water cooling).
6. Study of lubrication systems in automobiles.
7. Load test on 4-stroke single cylinder C.I. engine.
8. Load test on 4-stroke single cylinder S.I. engine.
9. Morse Test on multi-cylinder S.I. or C.I. engine
10. Load test on variable compression ratio S.I. engine
11. Load test and Heat balance on 2 stroke S.I. Engine

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP

BMEPC5120	MACHINING SCIENCE & TECHNOLOGY LABORATORY	0	0	2	1	

Pre -Requisite: Engineering Workshop, Mathematics

Course Educational Objectives

CEO1	To provide the student with personal, hands-on experience in the operation of standard machine tools
CEO2	To provide to the students an understanding and appreciation of the abrasive metal cutting processes.
CEO3	To provide a proper insight about the importance of lubrication and wear problems.
CEO4	To provide the students with a proper understanding of nontraditional machining processes.

Course Outcomes: Upon successful completion of this course, students should

CO1	Classify the basic principle and techniques of lathe, shaper and planner, drilling, milling and grinding machines.
CO2	Evaluate different cutting force acts during machining by lathe tool dynamometer
CO3	Define the concept and applications of modern machining processes.
CO4	Develop the design of job with proper dimension using CNC Lathe and milling.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2										
CO2	1			2										
CO3	1			2										
CO4	1			3										
Avg	1			2.25										

LIST OF EXPERIMENTS

LIST OF EXPERIMENTS: (Minimum 8 experiments)

1. Job on lathe with tapper turning, thread cutting, knurling and groove cutting (3 Experiments).
2. Gear cutting (with index head) on milling machine
3. Working with shaper, Planner and slotting machine.
4. Working with surface and cylindrical grinding.
5. Determination of cutting force using Lathe tool dynamometer.
6. Determination of cutting force in drilling using drill tool dynamometer.
7. Study of Non-traditional machining processes.(USM, AJM, EDM, ECM)
8. Study of CNC Lathe and demonstration of making job in CNC lathe.
9. Study of CNC Milling machine and demonstration of making job in CNC Milling machine.

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SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC5130	DESIGN OF MACHINE ELEMENTS LABORATORY	0	0	2	1	

Pre -Requisite: Engineering Drawing, Mathematics

Course Educational Objectives

CEO1	The primary objective of this course is to demonstrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied.
CEO2	The emphasis in this course is on machine design: the design and creation of devices that consist of interrelated elements used to modify force and/or motion
CEO3	The type of design addressed in this course is that of detailed design, which is to define the shape, size and material of a particular machine element such that it will not fail under the expected load and operating conditions.
CEO4	To design and draw the different components of mechanical Engineering system.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Construct an assembly drawing of tail-stock of lathe and screw jack including bill of materials
CO2	Draw the machine elements including riveted joint, cotter joint and knuckle joint
CO3	Design of shaft subjected to combined loading.
CO4	Design and drawing of flange coupling, lever, belt and pulley

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				2									2	
CO2			1	2	2									2
CO3			3	1	1									2
CO4			3		2									
Avg			1.75	1.25	1.25								0.5	1

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Assembly drawing of tail-stock of lathe with bill of materials
2. Assembly drawing of screw jack with bill of materials
3. Design & drawing of Riveted joint
4. Design and drawing of Cotter joint
5. Design and drawing of Knuckle joint
6. Design of shafts subjected to combined loading
7. Design and drawing of Flange coupling
8. Design of lever
9. Design and drawing of belt and pulley

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC5140	**DYNAMICS OF MACHINERY LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: Theory Of Machines

Course Educational Objectives

CEO1	Understand the principles of dynamics applied in Theory of machinery
CEO2	To verify the gyroscopic principle under dynamic loadings.
CEO3	To conduct experimentation to find the damping co-efficient for natural and forced frequencies.
CEO4	To analyze the static and dynamic balancing of different components.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Define the gyroscopic effects in ships, aero planes and road vehicles
CO2	Analyze and design centrifugal governors.
CO3	Analyze balancing forces in rotating and reciprocating machine components.
CO4	Determine co-efficient of damping for free and forced vibrations of single degree freedom systems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2										
CO2	1	2		2										
CO3	1			3										
CO4	1			3										
Avg	1	0.5		2.5										

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1.Study on Clutches
2. Determination of gyroscopic couple using gyroscopic test rig.
3. Performance characteristics of a spring loaded governor
4. Determination of critical speed of rotating shaft
5. Experiment on static and dynamic balancing apparatus
6.Experiment on Brake
7.Experiment on Dynamometers
8. Determination of natural frequencies of un damped as well as damped vibrating systems.
9. Experiment on evaluation of damping in a vibrating system.

VI SEMESTER [THIRD YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC6010	Heat Transfer	3	1	0	4	A
2	PC	BMEPC6020	Design of Machine Components	3	0	0	3	A
3	PE	BMEPE6031	Advanced Mechanics of Solid	3	0	0	3	A
		BMEPE6032	Advanced Fluid mechanics					
		BMEPE6033	Automobile Engineering					
		BMEPE6034	Advanced Welding Technology					
4	PE	BMEPE6041	Mechatronics	3	0	0	3	A
		BMEPE6042	Refrigeration & Air Conditioning					
		BMEPE6043	Quality Control And Reliability					
		BMEPE6044	CAD / CAM					
5	OE	B**OE6051	Open Elective-II *(Any One)*	3	0	0	3	A
		B**OE6052						
		B**OE6053						

		B**OE6054						
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3	A
		BMSHS5062	Organizational Behaviour					
PRACTICAL / SESSIONAL								
7	PC	BMEPC6110	Heat Transfer Lab	0	0	2	1	
8	PC	BMEPC6120	Design of Machine Components Lab	0	0	2	1	
10	PC	BMEPC6140	Advanced Lab-I	0	0	2	1	
11	HS	BTPHS6160	#Soft Skill and Employability Skill	0	0	2	1	
		TOTAL:		**18**	**1**	**8**	**23**	

SUBJECT CODE	**TITLE OF THE SUBJECT**	**L**	**T**	**P**	**C**	**QP**
BMEPC6010	**HEAT TRANSFER**	**3**	**1**	**0**	**4**	**A**

Pre -Requisite: Basics of thermodynamics

Course Educational Objectives

CEO 1	To understand the basic concept of mode of heat transfer.
CEO 2	To analyze the 1D and 2D heat conduction in form transient and with heat generation mode.
CEO 3	To study the thermal boundary layer, during convective heat transfer over a pipe or flat surface.
CEO 4	To Understand the effect of radiative heat transfer.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Recall the thermodynamics correlations and understand the fundamental modes of heat transfer like conduction, convection and radiation.
CO2	Evaluate the temperature distribution in steady state and unsteady state heat conduction.
CO3	Interpret and analyze convective heat transfer by using empirical correlations of external and internal, forced and free convection.

CO4	Design the heat exchanger with using LMTD and NTU methods.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												1
CO2	3	3												
CO3	3	3												
CO4	1	3	2											1
Avg.	2.5	2.5	0.5											0.5

SYLLABUS

UNIT:1 [15 Hours]

Introduction to heat transfer:

Modes of heat transfer: conduction, convection, and radiation ,Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance &Thermal resistance, Contact resistance, convective heat transfer coefficient, radiation heat transfer coefficient , Electrical analogy, combined modes of heat transfer.

Heat conduction:

The General heat conduction in Cartesian, polar-cylindrical and polar-spherical co-ordinates, Simplification of the general equation for one and two dimensional steady/transient conduction with constant/ variable thermal conductivity with / without heat generation.

Solution of the one dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases. Critical insulation thickness, Heat transfer in extended surfaces (pin fins) without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness. Conduction in solids with negligible internal temperature gradient (Lumped heat analysis)

UNIT:2 [15 Hours]

Convective heat transfer:

Introduction to convective flow - forced and free, Physical significance of Grashoff , Reynolds, Prandtl, Nusselt and Stanton numbers. Conservation equations for mass, momentum and energy for 2-dimensional convective heat transfer in case of incompressible flow, Hydrodynamic and thermal boundary layers for flow over a flat plate. Critical Reynolds number; general expressions for drag coefficient and drag force Reynolds-Colbourn analogy. Thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Use of empirical relations for solving turbulent conditions for external and internal flow. Mechanism of heat transfer during natural convection, Experimental heat transfer correlations for natural

convection in the following cases
(a) Vertical and horizontal plates
(b) Inside and outside flows in case of tubes

UNIT:3 [10 Hours]

Radiative heat exchange:

Introduction, Radiation properties, definitions of various terms used in radiation heat transfer; Absorptivity, reflectivity &transmissivity. Emissive power & emissivity, Kirchhoff's identity, Planck's relation for monochromatic emissive power of a black body, Derivation of Stefan-Boltzmann law and Wien's displacement law from Planck's relation, Radiation shape factor, Relation for shape factor and shape factor algebra. Heat exchange between black bodies through non-absorbing medium. Gray bodies and real bodies, Heat exchange between gray bodies. Radiosity and Irradiation, Radiation shields.

UNIT:4 [8 Hours]

Introduction, Types of heat exchanger, the overall heat transfer coefficient and fouling factors, LMTD and E- NTU analysis of heat exchangers. Heat transfer for boiling liquids and condensing vapours: Types of condensation, use of correlations for condensation on vertical flat surfaces, horizontal tube and; regimes of pool boiling, pool boiling correlations. Critical heat flux, concept of forced boiling. Numericals.

Teaching Methods: Chalk& Board

Text Books

1. Heat Transfer : R.K.Rajput, Laxmi Publications
2. Fundamentals of Engineering Heat and Mass Transfer: R.C.Sachdeva, New Age International.
3. Heat and Mass Transfer by Yonus A Cengel, TMH

Ref. Books:

1 Heat Transfer: P.S.Ghosdastidar, Oxford University Press
2. Heat Transfer by P.K. Nag, TMH
3. Heat Transfer by S.P. Sukhatme, TMH
4.Heat Transfer Tenth Edition.J.P.Holman

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPC6020	DESIGN OF MACHINE COMPONENTS	3	0	0	3	A

Pre -Requisite: Engg. Mechanics, Mechanics of Solids, Material science, Machine Design

Course Educational Objectives

CEO1	This course is intended to introduce the mechanical engineering students to the basic components of machinery, and how to select and size these components to achieve design goals in the construction of mechanical system
CEO2	To familiarize the various steps involved in the Design Process and to understand the principles involved in evaluating the shape and dimensions of a component

CEO3	To satisfy functional and strength requirements and learn to use standard practices and standard data of machine components.
CEO4	To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice and obtaining design solutions to open-ended problems through a systematic design process

Course Outcomes: *Upon successful completion of this course, students should be able to*:

CO1	Classifythe types of Bearing, application and material of bearing.
CO2	Design the pressure vessels and lever.
CO3	Analyze the design of belt drives and gears.
CO4	Design of Flywheel and I.C engine Components.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	3											2
CO2	1	3	2											1
CO3	2	1	1											
CO4	1	1	1											3
Avg.	1.75	1.5	1.75											1.5

SYLLABUS

UNIT:1 [16 Hours]

BEARINGS: Classification of bearings- applications, types of journal bearings, lubrication, bearing modulus, full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball &amp, roller bearings, bearing life.

UNIT:2 [12 Hours]

Design of Pressure vessels: Thin pressure vessels: cylindrical and spherical vessels, Design of end Closures, Thick cylindrical shells. Design of Lever: Classification, Design of levers, Cranked lever, Lever of safety - valve

UNIT:3 [12 Hours]

Design of belt drive and power screw: Design of belt drive and pulley, Power screw design with square thread such as screw jack.Gears: Design of Spur, Helical, bevel and worm gears.

UNIT:4 [10 Hours]

Flywheel: Design of Flywheel. Design of I.C. Engine components: Design of Cylinder, Piston, Connecting Rod, CrankShaft.

Teaching Methods: Chalk& Board/ PPT

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
2. Design of Machine Elements by C. S. Sharma and K. Purohit, PHI

Ref. Books:

1. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH
2. Machine Design, P.Kanaiah, Scietech Publications
3. Fundamentals of Machine Component Design by R.C.Juvinall and K.M.Marshek, John Wiley &Sons

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6031	ADVANCED MECHANICS OF SOLID	3	0	0	3	A
Pre -Requisite: Fundamentals in mathematics, Engg. Mechanics and Material science						
Course Educational Objectives						
CEO	Explain the students of different types of mechanical elements, structural bodies					

1	and their application
CEO 2	By Appling different types of theories of failure, strength of the machine elements, structural bodies can be determined
CEO 3	Summarize the social need of the particular elements and their cost effective design satisfying for the need of society.
CEO 4	Make use of the concept of stress and strain in different types of beam, structure analysis, and design in machine elements.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Develop principles of elasticity theory to determine stresses and strains
CO2	Apply theory of elasticity and formulate plane stress and plane strain problems
CO3	Estimate stresses and deflection of beams under unsymmetrical bending and to locate shear Centre of thin wall beams.
CO4	Analyze solid mechanics problem using classical methods and energy methods.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											1	
CO2	2	3												
CO3	1	3												1
CO4	2	3												
Avg.	2	2.75											0.25	0.25

SYLLABUS

UNIT:1 [14 Hours]

Analysis of stress:-

Introduction to stress analysis in elastic solids - stress at a point – stress tensor – stress components in rectangular coordinate system - Cauchy's equations – stress transformation – principal stresses and planes –stress invariants - hydrostatic and deviatoric stress components, octahedral shear stress –differential equations of equilibrium, plane stress, Mohr's circle for 3D state of stress.

Analysis of strain:-

Engineering strain - strain tensor (basics only) – analogy between stress and strain tensors - strain-displacement relations (small-strain only) – stress compatibility equation, Airy's stress function and Bi-harmonic equation

UNIT:2 [12 Hours]

Axisymmetric problems – governing equations – application to thick cylinders, compound cylinder, shrink fit, Bending of Curved Beam, stress distribution in beam with rectangular, circular & trapezoidal section. Stresses in crane hook, ring and chain link

Unsymmetrical bending of straight beams, Deflection of unsymmetrical bending.
UNIT:3 [12 Hours] Strain energy of deformation – special cases of a body subjected to concentrated loads, moment or torque - reciprocal relation – strain energy of a bar subjected to axial force, shear force, bending moment and torque. Maxwell reciprocal theorem – Castigliano's first and second theorems – virtual work principle – minimum potential energy theorem.
UNIT:4 [10 Hours] Torsion of non-circular bars: Saint Venant's theory - solutions for circular and elliptical cross-sections Prandtl's method - solutions for circular and elliptical cross-sections - membrane analogy.Torsion of thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections Variable stresses – reversed cyclic stress, fluctuating stress, alternating stress, stress concentration, stress concentration factor, notch sensitivity
Teaching Methods: Chalk& Board
Text Books: 1. Advanced Mechanics of Solids, L.S. Srinath, Tata McGraw Hill 2. Advanced Mechanics of Materials : Boresi and Schmdt, Willey
Ref. Books: 1. Advanced Mechanics of Materials : Siley and Smith 2. Strength of Materials Vol.II, by S.Timoshenko 3. Mechanical Metallurgy by Dieter

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Subject Code	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6032	ADVANCE FLUID MECHANICS	3	0	0	3	A

Pre -Requisite: Mathematics, Basics of Mechanics and Fluid Mechanics and Hydraulic Machines

Course Educational Objectives

CEO 1	To understand the basic tools for the analysis and solution of different types of flows
CEO 2	To derive the partial differential equations governing the conservation of mass, momentum, and energy of an incompressible Newtonian fluid
CEO 3	To obtain dimensionless form of the governing equations and extract the dimensionless parameters from them to determine the flow field.
CEO 4	To derive the boundary layer equations and show how to obtain exact and approximate integral solutions.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Demonstrate the concept of fluid mechanics like statics, kinematics and dynamics, including concepts of mass, momentum and energy conservation equation.
CO2	Apply the principles of high and low Reynolds number flows to fluid flow systems.
CO3	Review the concepts of boundary layer and flow in transition.
CO4	Apply the fundamentals of one dimensional isentropic flow to variable area duct and principles of compressible flow to constant area duct subjected to friction or heat transfer

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	2	3												
CO3	2	2												
CO4	2	3												
Avg.	2.25	2.25												

SYLLABUS

UNIT:1 [14 Hours]

Basic Concepts and Fundamentals; Definition and properties of Fluids, Fluid as continuum, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics. Potential Flows: Revisit of fluid kinematics, Stream and Velocity potential function, Circulation, Irrotational vortex, Basic plane potential flows: Uniform stream; Source and Sink; Vortex flow, Flow past a circular cylinder, Concept of lift and

drag

UNIT:2 [12 Hours] Governing Equations of Fluid Motion, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation. Exact solutions of Navier-Stokes Equations: Poiseuille flows.
UNIT:3 [10 Hours] Laminar Boundary Layers; Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Turbulent Flow; Introduction, General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer
UNIT:4 [10 Hours] Compressible Flows; Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Fanno curve. Introduction to Computational Fluid Dynamics; Boundary conditions, Basic discretization – Finite difference method, Finite volume method and Finite element method
Teaching Methods: Chalk& Board
Text Books: 1. Fluid Mechanics by A K Mohanty, TMH Publication 2. Fluid Mechanics by S K Som, TMH Publication
Ref. Books: 1. Fluid Mechanics by F M White, TMH Publication 2. Fundamentals of Fluid Mechanics, Schlitching 3. Fluid Mechnics:Cengel and Cimbala, TMH Publication

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6033	AUTOMOBILE ENGINEERING	3	0	0	3	A

Pre -Requisite: Internal Combustion Engine, Kinematics and Dynamics of Machines

Course Educational Objectives

CEO 1	To impart practical and theoretical knowledge in both practically by covering the various types of power-driven vehicles
CEO 2	To familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system
CEO 3	To make the students acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles
CEO 4	To make the students aware of the various electrical vehicles and electrical system of automobiles

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	List out the different components and systems of an automobile.
CO2	Illustrate the constructional designs and working principles involved in vehicle design.
CO3	Utilize steering geometry, principle of gear box design and braking system for effective power transmission of vehicles
CO4	Develop electrical vehicles considering environmental safety

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													1
CO2	1	2	1											2
CO3		3	2											2
CO4			2				1							3
Avg.	0.75	1.25	1.25				0.25							2

SYLLABUS

UNIT:1 [14 Hours]

Introduction:

Main units of automobile chassis and body, different systems of the automobile, description of the main parts of the engine, motor vehicle act.

Power for Propulsion: Resistance to motion, rolling resistance, air resistance, gradient resistance, power required for propulsion, tractive effort and traction, road performance curves.

Braking systems: Hydraulic braking system, braking of vehicles when applied to rear, front and all four wheels, theory of internal shoe brake, design of brake lining and brake drum, different arrangement of brake shoes, servo and power brakes.

UNIT:2 [12 Hours]

Transmission Systems: Layout of the transmission system, main function of the different components of the transmission system, transmission system for two wheels and four wheels drives. Hotchkiss and torque tube drives.

Gear box :

Sliding mesh, constant mesh and synchromesh gearbox, design of 3 speed and 4 speed gear box, over drive, torque converter, semi and fully automatic transmission. Hooke's joint, propeller shaft, differential, rear axles, types of rear axles, semi floating, three quarter floating and full floating types.

UNIT:3 [10 Hours]

Front wheel Geometry and steering systems : Camber, castor, kingpin inclination, toe-in and toe-out, centre point steering condition for true rolling, components of steering mechanism, power steering (Hydraulic & Pneumatic).

Ignition System: Requirements of an ignition system, conventional ignition system (Battery and Magneto), Modern ignition system (TCI, CDI), Spark advance mechanism.

UNIT:4 [10 Hours]

Electrical system of an automobile : Starting system, charging system, other electrical system. Electrical vehicles: History, electrical vehicles and the environment pollution, description of electric vehicle, Operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Models

Text Books:

1. Automobile Mechanics , N.K.Giri, Khanna publishers
2. Automobile Engineering, K.M. Gupta, Voll & II, Umesh Publication
3. Automobile engineering, kripal shing vol I & II Standard Publishers Distributors

Ref. Books:

1. Automotive mechanics: William h. Crouse and Donald L. Anglin, TMH
2. The motor vehicle, Newton and Steeds
3. Automobile Mechanics, J. Heitner, East West Press

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6034	**ADVANCED WELDING THECHNOLOGY**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Basics of manufacturing process and materials.

Course Educational Objectives

CEO 1	To impart knowledge regarding various advanced welding practices in industries
CEO 2	To understand the various parameters and requirements for welding processes
CEO 3	To apply the right kind of welding technique suitable for different materials
CEO 4	To evaluate the characteristics and properties of various metals and the related chemical, physical and mechanical properties

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Relate the theoretical aspects of welding technology in depth.
CO2	Describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy.
CO3	Select the suitable welding power sources and determine the mechanism of metal transfer in welding
CO4	Evaluate the basic principle of advanced welding techniques and the appropriate welding process for a particular application

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	2	2											3	
CO3	2	2												2
CO4	2	2												3
Avg.	2.25	1.75											0.75	1.25

SYLLABUS
UNIT:1 [13 Hours] WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behavior and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes. WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ.
UNIT:2 [10 Hours] WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics
UNIT:3 [08 Hours] COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires. METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate
UNIT:4 [13 Hours] SOLID STATE WELDING: Theory and mechanism of solid state welding. Techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding. High energy rate welding. Analysis of the Process. WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes. Under water welding-process & problem.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert
Text Books: 1. R.S.Parmar, "Welding processes & Technology", Khanna Publishers. 2.S.V. Nandkarni, "Modern Arc Welding Technology", Oxford &IDH publishing Co
Ref. Books: 1. L.M.Gourd, "Principles of Welding Technology", ELBS/ Edward Arnold. 2. Richard L. Little, "Welding & Welding Technology", Mc-Graw Hill. 3.Rossi, "Welding Technology", Mc-Graw Hill

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6041	**MECHATRONICS**	**3**	**0**	**0**	**3**	**A**

Pre –Requisite: Basics of Electronics

Course Educational Objective

CEO 1	To impart the knowledge of Microprocessors, Microcontrollers, and PLCs' and its role in Mechatronic systems
CEO 2	To introduce the students, the fundamentals of interdisciplinary engineering components and their integration in Mechatronic systems design approach
CEO 3	Be able to do the complete design, building, interfacing and actuation of a mechatronic system for a set of specifications
CEO 4	Relate various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Model and analyze electrical and mechanical systems and their interconnection.
CO2	Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.
CO3	Describe mechatronic systems and overview of control systems & actuators
CO4	Differentiate between various sensors, transducers and actuators and their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												

CO2	3	3	2											2
CO3	3	2												
CO4	2	1												1
Avg.	2.75	2.25	0.5											0.75

SYLLABUS

UNIT:1 (10 HOURS)

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products,

Signal theory, signal analysis and processing, Laplace transformation, Z transformation modulation and de modulation. Electrical components and Electronic device –Resister, inductor and capacitor, reactance and impedance. Basic electronics devices junction diodes, Bipolar transistors

UNIT:2 (10 HOURS)

Basic Digital Technology : Digital number system, Binary number system, Hexadecimal number

system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP FLOP, Registers counters. System modeling : Frequency response, Mechanical system, electrical system, Thermal system, Fluid system.

UNIT:3 (10 HOURS)

Actuators Electric motors; D.C. Motors, Stepper motor, , Hydraulic actuators, Pneumatic Actuators Transducer and Sensors : Principles, difference between transducer and sensors, transducer types – photo emissive, photo conductive, photovoltaic, thermistors, Thermocouple, Inductive, capacitive, Peizoelectric, Hall effect transducers, Ionization transducer, Encoders Incremental encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell

UNIT:4 (10 HOURS)

Programmable Logic controller : Basic Structure Programming : Ladder diagram Timers, Internal Relays and Counters Shift Registers Master and Jump Controls, data handling , Analog input / output , PLC Selection &Application. Microprocessor ad Microcontroller : Microprocessor based Digital control, registers, Program counter, Intel 8085 microprocessor

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

TEXT BOOKS :

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

REFERENCE:

1. "Designing Intelligent Machines". open University, London.
2. Michel B. Histand and David G. Alciatore,"
3. Introduction to Mechatronics and Measurement systems, "Tata MC Graw hill
4. I. C.W. Desi ha, "Control sensors and actuators," Prentice Hall.
5. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
6. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers.
7. Mechatronics System Design / Devdas shetty/Richard/Thomson.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6042	**REFRIGERATION AND AIR CONDITIONING**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Basic of thermodynamics						
Course Educational Objectives						
CEO 1	Explain how thermodynamic principles are applied within the refrigeration and Air conditioning, methods of lowering the temperature in single compression System.					
CEO 2	Summarize about various system components and accessories of air-craft Refrigeration system, VCRS, VARS and different air-conditioning system.					
CEO 3	Apply knowledge of principles of producing low temperatures by using multi compressor, multi-evaporator systems and cascade systems.					
CEO 4	Illustrate the different types and classification of refrigerant with its properties, To carry-out cooling load calculations for different applications.					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Recall the basic principle of thermodynamics and understand various refrigeration systems like air refrigeration, vapor compression and absorption refrigeration etc.					

CO2	Evaluate and explain various terminologies involved in psychometric process.
CO3	Estimate cooling load calculations for various air-conditioning systems.
CO4	Design human comfort air conditioning systems related to cooling load estimations.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	3												
CO3	2	3												
CO4	1	2	3											
Avg.	2	2.25	0.75											

SYLLABUS

UNIT:1 [12 Hours]

Air Refrigeration System: Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Air-craft with problems.

Vapour Compression System: Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, sub-cooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution

UNIT:2 [10 Hours]

Multi-stage compression and Multi-evaporator systems: Different arrangements of compressors and inter-cooling, Multistage compression with inter-cooling, Multi-evaporator system, Dual compression system. Simple problems

UNIT:3 [10 Hours]

Vapour Absorption System: Simple Ammonia - absorption system, Improved absorption system, Electrolux/Three fluid system, Lithium-bromide-water vapour absorption system, comparison of absorption system with vapour compression system. Simple Problems and solution. Thermoelectric Refrigeration, Magnetic Refrigeration.

Refrigerants: Classification of refrigerants and its designation- Halocarbon (compounds, Hydrocarbons, Inorganic compounds, Azeotropes, Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Brines. Alternative refrigerants (Organic and inorganic compounds).

UNIT:4 [13 Hours]

Psychrometrics: Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, De-humidification, Mixture of air streams. Review question and discussions.

Requirements of comfort air conditioning: Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Refrigeration and Air Conditioning by R.S. Khurmi. 2. Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons
Ref. Books: 1. Refrigeration and Air conditioning by P.L. Balloney, Khanna Publishers. 2. Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6043	**QUALITY CONTROL & RELIABILITY**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: basics of probability and statics						
Course Educational Objectives						
CEO 1	This course introduces students to concepts and methods of modern statistical quality control					
CEO 2	Students learn to apply standard quality control tools. They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations					

CEO 3	They learn theory and methods for analyzing the performance of different quality control tools
CEO 4	The use of appropriate software for statistical and quality analysis is taught, and is necessary for successful completion of some homework assignments. Issues of ethics and professional responsibility and their relation to product quality are discussed

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand the concepts of quality control, improvement and management.
CO2	Relevant with sampling by attributes, operating characteristics curves and ISO standard set attributes in sampling plans
CO3	Apply quality engineering tools to the design of products and process controls
CO4	Recognize the need of reliability and carry out reliability data analysis

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	2	2												1
CO3	1		2		2									
CO4	3	1												1
Avg.	2.25	1	0.5		0.5									0.5

SYLLABUS

UNIT:1 [16 Hours]

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost- Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and □ chart -process capability – process capability studies and simple problems.

Control chart for attributes –control chart for nonconforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT:2 [09 Hours] 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 sampling plans.
UNIT:3 [10 Hours] Total Quality Management perspective, methodologies and procedures; Roadmap to TQM, ISO 9000, KAIZEN, Quality Circles, Six sigma concepts, JIT. Taguchi Loss function, Orthogonal Array, Linear Graphs, Parametric Design, S/N Ratio, ANOVA
UNIT:4 [10 Hours] Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: 1. Douglas's. Montgomery, "Introduction to Statistical quality control", 4th edition, John Wiley 2001. 2. A.Mitra, Fundamentals of Quality Control and Improvement, Pearson Education, 2nd ed. 2005.
Ref. Books: 1. John's. Oakland. "Statistical process control", 5th edition, Elsevier, 2005 2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993 3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE6044	CAD / CAM	3	0	0	3	A

Pre -Requisite :Design and Drafting, Simulation

Course Educational Objectives

CEO 1	To understand the Design process, Creating the Manufacturing Database.
CEO 2	To develop the Configuration, Graphics Packages, Database structure and content, Wire frame and solid modeling.
CEO 3	Classify Manual and Computer Aided programming, studying Problems with conventional NC, NC technology: CNC, DNC, Combined DNC/ CNC system.
CEO 4	To learn the Data exchange formats, Finite element analysis, Rapid prototyping.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand the basic fundamentals of computer aided design and manufacturing and to learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
CO2	Categorize different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc.
CO3	Explain the part programming, importance of group technology; computer aided process planning, computer aided quality control.
CO4	Compile the overall configuration and elements of computer integrated manufacturing systems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	2	2												
CO3	3	1												
CO4	2	2												
Avg.	2.5	1.75												

SYLLABUS

UNIT:1 (14 Hours)

Fundamentals of CAD: Design process, Applications of computer for design, Creating the Manufacturing Database, The Design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, Central Processing

Unit, Memory types
UNIT:2 (14 Hours) Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, Transformations of geometry, Database structure and content, Wire frame versus solid modeling, Constraint– Based modeling, Geometric commands, Display control commands, Editing
UNIT:3 (14 Hours) CAM - Numerical Control and NC Part Programming: Numerical Control, Numerical Control elements, NC Cordinate system, NC motion control system, Manual and Computer Aided programming, the APT language, Miscellaneous Functions, M, Advanced part-programming methods. Problems with conventional NC, NC technology: CNC, DNC, Combined DNC/ CNC system, Adaptive control manufacturing systems, Computer Integrated Manufacturing system, Machine Tools and related equipment, Materials Handling system: AGV, Robots, Lean manufacturing.
UNIT:4 (10 Hours) Data Exchange Formats and Applications: Data exchange formats, Finite element analysis, Rapid prototyping. Robotics: Anatomy & configuration of robot, Characteristics of robots, Grippers, Application of robots in manufacturing, Robot programming. Group Technology: Introduction to Group technology,
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures
Text Books 1. CAD/CAM Computer Aided Design and Manufacturing, M.P.Goover and E.W.Zimmers, Jr., Pearson. 2. CAD & CAM, J Srinivas, Oxford University Press
Ref. Books 1. CAD/CAM Theory and Practice, Zeid and Subramanian, TMH 2. CAD/CAM Principles, Practice and Manufacturing Management, McMahon and Browne, Pearson Education 3. CAD/CAM Concepts and Applications, C.R.Alavala, PHI

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BBSBS5061	**OPTIMIZATION IN ENGINEERING**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Basics of Mathematics, matrix, partial differential equation addition of linear equations						
Course Educational Objectives						
CEO1	To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science					
CEO2	To provide students with opportunity using various software package for solving liner programming and integer programming models					
CEO3	To introduce the students to use of basic methodology for solution of linear programs and integer programs					
CEO4	To introduce the students to advance methods for large scale transportation and assignment problems					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Analyze, formulate and solve linear programming problems using appropriate techniques.					
CO2	Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship					
CO3	Develop mathematical skills to analyze and solve integer programming problem arising from a wide range of applications.					
CO4	Communicate ideas, explain procedures and interpret results and solutions					
CO-PO & PSO Mapping						
COs	PROGRAMME OUTCOMES					PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												
CO2	3	3												
CO3	3	2												
CO4		3												
Avg.	2.25	2.75												

SYLLABUS

UNIT:1 [14 Hours]

Introduction Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, Big-M method, duality theory, primal-dual relationships, sensitivity analysis.

UNIT:2 [14 Hours]

Transportation and Assignment Problems Specific features of transportation problem, streamlined simplex method for solving transportation problems, special features of assignment problems, Hungarian method for solving assignment problems. Integer programming: Special features, binary integer programming models-branch-and-bound technique.

UNIT:3 [10 Hours]

Dynamic Programming Characteristics, principle of optimality, solution procedure, deterministic problems. Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.

UNIT:4 [10 Hours]

Non-linear programming-Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

Teaching Methods: Chalk& Board/PPT

Text Books:

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book 2.KantiSwarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7thEdition, Sultan chand& Sons, New Delhi, 2005

Ref. Books:

12. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd
13. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7thEdition, TMH, 2009.
14. Kalyanmoy Deb, "Optimization for Engineering Design", PHI Learning Pvt Ltd

SUBJECT CODE	NAME OF THE SUBJECT	L	T	P	C	QP
BMGHS5062	ORGANISATIONAL BEHAVIOUR	3	0	0	3	A
Pre -Requisite:						
Course Educational Objectives						
CEO1	To develop an understanding of the behaviour of individuals and groups inside organizations					
CEO2	To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.					
CEO3	To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.					
Course Outcomes: Upon successful completion of this course, students should be able to:						
CO1	Define, explain and illustrate a range of organizational behaviour theories.					
CO2	Analyse the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts.					
CO3	Explain about organisational culture. How organisational culture plays important role towards organisational success					
CO4	Communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and thetorical conventions about organisational changes					
CO-PO & PSO Mapping						
COs	PROGRAMME OUTCOMES				PSOs	

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3		2	1					
CO2						2		2	2					
CO3						1		1	2					
CO4						1		1	3					
Avg.						1.75		1.5	2					

SYLLABUS

Unit – I [10Hrs]

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive), Limitations of OB.

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behaviour and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Unit - II [7Hrs]

Foundations of Group Behaviour: The Meaning of Group & Group behaviour & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.

Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.

Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Unit – III [6 Hrs.]

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Unit – IV [8 Hrs.]

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.

Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model,

Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 3. Understanding Organizational Behaviour, Parek, Oxford 4. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
Reference books: 4. Organizational Behaviour, K. Awathappa,HPH. 5. Organizational Behaviour, VSP Rao, Excel 6. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage. Organizational Behaviour, Hitt, Miller, Colella, Wiley

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC6110	**HEAT TRANSFER LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: Basics of Thermodynamics

Course Educational Objectives	
CEO1	To demonstrate the concepts discussed in the Heat Transfer course
CEO2	To experimentally measure the effectiveness of heat exchangers.
CEO3	To experimentally determine thermal conductivity and heat transfer coefficient through various materials.
Course Outcomes: Upon successful completion of this course, students should be	
CO1	Demonstrate and organize the thermal conductivity of composite slab by testing
CO2	Define and find the heat transfer coefficient in natural/forced convection by a particular equipment
CO3	Relate the performance of heat exchanger types of parallel flow and counter flow
CO4	Explain and Interpret the effectiveness of natural and forced convection through fins, the advantage of fins in heat transfer

CO-PO & PSO Mapping		
COs	PROGRAMME OUTCOMES	PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				3						1				1
CO2		1		2						2				
CO3				2						2				1
CO4		1		2						2				
Avg		0.5		2.25						1.75				0.5

LIST OF EXPERIMENTS

List of Experiments:

1. Determination of Thermal conductivity of composite slab
2. Determination of heat transfer coefficient in natural or forced convention.
3. Determination of surface emissivity
4. Performance test on parallel flow and counter flow heat exchanger
5. Determination the efficiency and effectiveness of fins by natural convection.
6. Determination of Fin Efficiency and Effectiveness by forced convention.
7. Determination of Critical heat flux during boiling heat transfer.
8. Verification of Stefan Boltzman's law.

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC6120	**DESIGN OF MACHINE COMPONENTS LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: None

Course Educational Objectives

CEO1	To draft and capture for theories of failure for a system.
CEO2	To familiar with mechanism and application of clutches through design and
CEO	To understand the effect of inertia by design and drafting piston and
CEO4	To explain the importance of gears through design of straight and helical gear.

Course Outcomes: Upon successful completion of this course, students should

CO1	Build the knowledge on basic machine elements used in machine design
CO2	Judge and quantify failure of pressure vessels.
CO3	Analyze the stress and strain on mechanical components.
CO4	Apply the techniques, skills necessary for engineering practice

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		2	2							1				
CO2		2	2							2			2	
CO3		2	3							2			2	
CO4		2		1						2			1	
Avg		2	1.75	0.25						1.75			1.25	

LIST OF EXPERIMENTS

List of Experiments:

1. Design of thin/ thick cylindrical shells under internal fluid pressure
2. Design of lever
3. Design of Journal Bearing
4. Design of straight/ helical gears
5. Design of piston
6. Design of connecting rod
7. Design of crank shaft
8. Design of fly wheel

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC6140	**NUMERICAL COMPUTATION & SOLIDS MODELING LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: AUTOCAD/CATIA , Mathematics III:

Course Educational Objectives

CEO1	To understand the principles of numerical computational methods.
CEO2	To apply suitable technique for different problems by using MAT LAB
CEO3	To develop solid models of different mechanical components.
CEO4	To analyze different components by using different simulation programs.

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand the programming language of MATALAB.
CO2	Determine optimum solutions for numerical methods by using MATLAB program
CO3	Design 2D and 3D models for different mechanical components by modelling programs.
CO4	Analyse the simulation by assembling various components.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2						1				
CO2			2	2	3					1				1
CO3			1	1	2					1				
CO4				2	3					1				1
Avg	0.25		0.75	1.75	2					1				0.5

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

(A) NUMERICAL COMPUTATION. (Minimum 05 problems)
(Using MATLAB or other software/language)

1. Basics of MATLAB or similar software/language
2. Finding solution by Numerical Methods (including graphics) for the following:
   a. Bisection Method
   b. Newton-Raphson Method
   c. Secant Method
   d. Gauss Elimination Method
   e. Initial-Value Problems (e.g. Runge-Kutta Method)
   f. Boundary Value Problem (eg. Shooting Method)
   g. Eigen Value Problem

(B) SOLIDS MODELING (5 Models)
(Using Solid Modelling software eg. AUTOCAD/ProE/CATIA/SolidWorks/ UNIGRAPHICS etc.)

1. Learning the Basics of Solid Modelling Software
2. Modelling in 2D and image scanning.
3. Modelling in 3D of machine tool parts like gear details, machine tool beds, Tailstocks and assembly drawings of machine tools like lathe machine components, power drives, jigs & fixtures, power presses etc. Use of various types of surfaces in 3D modelling, animation features and other editing entities in machine tool assemblies.

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC6140	**NUMERICAL COMPUTATION & SOLIDS MODELING LABORATORY**	**0**	**0**	**2**	**1**	

Pre -Requisite: AUTOCAD/CATIA , Mathematics III:

Course Educational Objectives

CEO1	To understand the principles of numerical computational methods.
CEO2	To apply suitable technique for different problems by using MAT LAB
CEO3	To develop solid models of different mechanical components.
CEO4	To analyze different components by using different simulation programs.

Course Outcomes: Upon successful completion of this course, students should be

CO1	Understand the programming language of MATALAB.
CO2	Determine optimum solutions for numerical methods by using MATLAB program

CO3	Design 2D and 3D models for different mechanical components by modelling programs.
CO4	Analyse the simulation by assembling various components.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2										
CO2			2	2	3									1
CO3			1	1	2									
CO4				2	3									1
Avg	0.25		0.75	1.75	2									0.5

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

(A) NUMERICAL COMPUTATION. (Minimum 05 problems)
(Using MATLAB or other software/language)

1. Basics of MATLAB or similar software/language
2. Finding solution by Numerical Methods (including graphics) for the following:
   a. Bisection Method
   b. Newton-Raphson Method
   c. Secant Method
   d. Gauss Elimination Method
   e. Initial-Value Problems (e.g. Runge-Kutta Method)
   f. Boundary Value Problem (eg. Shooting Method)
   g. Eigen Value Problem

(B) SOLIDS MODELING (5 Models)
(Using Solid Modelling software eg. AUTOCAD/ProE/CATIA/SolidWorks/ UNIGRAPHICS etc.)

1. Learning the Basics of Solid Modelling Software
2. Modelling in 2D and image scanning.
3. Modelling in 3D of machine tool parts like gear details, machine tool beds, Tailstocks and assembly drawings of machine tools like lathe machine components, power drives, jigs & fixtures, power presses etc. Use of various types of surfaces in 3D modelling, animation features and other editing entities in machine tool assemblies.

TEXT BOOKS

01. Applied Numerical Analysis, by Curtis F Gerald & Patrick G Wheatley; Pearson Education Ltd.
02. Introductory Methods of Numerical Analysis, by SS Sastry; Prentice Hall of India, New Delhi
03. Applied Numerical Methods with MATLAB, S.C.Chapra, TMH
04. Numerical Methods for Engineers and Scientists, J.D.Hoffman, CRC Press
05. Numerical Methods, E Balagurusamy, TMH
06. Numerical Methods for Engineers, Chapra and Canale, TMH
07. MATLAB Programming for Engineers, Chapman, Thomson Learning

08. Getting Started with MATLAB, Rudra Pratap, Oxford University Press
SOLID MODELLING SOFTWARES
AUTOCAD, CATIA, SOLIDWORKS etc.
ANALYSIS SOFTWARES –MATLAB

VII SEMESTER [FOURTH YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BMEPC7010	Industrial Engineering	3	0	0	3	A
2	PE	BMEPE7021	Finite Element Methods	3	0	0	3	G
		BMEPE7022	Advanced IC Engine					A
		BMEPE7023	Modern Manufacturing Processes					A
		BMEPE7024	Non-Destructive Evaluation & Testing					C
3	PE	BMEPE7031	Computational fluid Dynamics	3	0	0	3	A
		BMEPE7032	Additive Manufacturing					B
		BMEPE7033	Mechanical Vibration					G
		BMEPE7034	Tribology					F
4	PE	BMEPE7041	Design and Analysis of Heat Exchanger	3	0	0	3	A
		BMEPE7042	Fire and safety engineering					A
		BMEPE7043	Robotics and Robot application					G
		BMEPE7044	Nano Science					G
5	OE	B**OE7051	Open Elective-III*(Any One)*	3	0	0	3	A
		B**OE7052						
		B**OE7053						
		B**OE7054						
PRACTICAL / SESSIONAL								
6	PC	BMEPC7110	Industrial Engineering Laboratory	0	0	2	1	
7	PC	BMEPC7140	Advanced Laboratory -II	0	0	2	1	
8	PC	BMEPC7150	Mini Project / Projects on Internet of Things	0	0	6	3	
9	PE	BMEPE7160	## Massive Open Online Course (MOOC)	0	0	4	2	
10	PC	BMEPC7170	^Summer Internship-II	0	0	2	1	

		TOTAL:		**15**	**0**	**16**	**23**	

SUBJECT CODE	**TITLE OF THE SUBJECT**	**L**	**T**	**P**	**C**	**QP**
BMEPC7010	**INDUSTRIAL ENGINEERING**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Inventory control, Basics of Production Engineering

Course Educational Objectives

CEO 1	To educate basics of industrial engineering on the basis of productivity growth.
CEO 2	To develop an idea of safe work system design and selection of appropriate method for a process.
CEO 3	To build up an entrepreneurial skill through the topics like layout design, forecasting and inventory control.
CEO 4	To impart current advanced trends of different industries.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Outline the concept of industrial engineering and the factors affecting productivity of industries.
CO2	Apply different techniques for better work system design.
CO3	Analyze the data collected from different sections of organization for planning and control.
CO4	Adapt the emerging trends of industrial engineering.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												
CO2	1	2	2											
CO3	2	3												
CO4	1	3												
Avg.	1.5	2.5	0.5											

SYLLABUS

UNIT:1 [10 Hours]

Meaning, Definition, Objective, Need, Scope, Evolution and developments.

PRODUCTIVITY: Definition of productivity, individual enterprises, task of management Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs.

UNIT:2 [14 Hours]

Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors of affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM), Measurement of wages and incentives. Definition, objective and scope of work study. Human factors in work study. Work study and management, work study and supervision, work study and worker.

WORK MEASUREMENT: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, random observation, conducting study.

ERGONOMICS: Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences.

UNIT:3 [14 Hours]

PRODUCTION PLANNING AND INVENTORY CONTROL

Generalised model of a production system, Different kinds of production systems, mass, batch job and cellular production

Layout: Optimisation in Product and Process layout; FMS; Manufacturing Strategies

Demand forecasting: Moving Average and Exponential Smoothing methods, Multiple regression method, Error in forecasting.

Inventory control: EOQ and EBQ, EOQ Sensitivity, Backordering, Determination of safety stock, P and Q System, Joint cycle for multiple products

UNIT:4 [10 Hours]

CURRENT TRENDS: Introduction to Lean and Six Sigma, Just in time, Total quality management, 5 pillars of TPM, Enterprise resource planning, Supply chain and logistics management.(Definition)

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books:

1. Production and Operations Management by Everette E. Adam, Jr. Ronald J. Ebert; Publisher: Prentice Hall of India
2. Production and Operations Management by Panneerselvam R; Publisher: Prentice Hall of India

Ref. Books:

15. Operations Management by Shafer Scott M; Publisher: John Wiley
16. Introduction to work study" by ILO

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7021	**FINITE ELEMENT METHODS**	**3**	**0**	**0**	**3**	**G**

Pre -Requisite: Basic Mathematics, Mechanics of solid

Course Educational Objectives

CEO 1	To teach the basic principles, design and modeling considerations in using finite element Method.
CEO 2	Make the students to develop stiffness matrices for spring, truss, beam, plane stress problems and three dimensional problems.
CEO 3	To teach the finite element method to solve structural, fluid flow and thermal problem.
CEO 4	To teach the basics of FEM to solve various engineering problems.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain the application and characteristics of FEM for the elements such as bars, beams, plane, isoperimetric elements, and 3-D element.
CO2	Apply the concepts behind variational methods and weighted residual methods in FEM
CO3	Analyze the element characteristic equation procedure and generation of global stiffness equation will be applied.
CO4	Select the finite element method to solve problems involving axisymmetric solids subjected to axisymmetric loadings, fluid flow and heat conduction.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												
CO2	2	2												
CO3	3	2												
CO4	2	2												
Avg.	2.25	2												

SYLLABUS

UNIT:1 [06 Hours]

FEM fundamental concepts, Difference between classical method and FEM and FDM, Application of FEM, Advantages and limitation of FEM, Commercial softwares used for FEM. Preprocessing, processing and post processing.

UNIT:2 [08 Hours]

Variational principles, Rayleigh Ritz and Galerkin Methods, Ellimination and penalty approaches, Finite Element Modeling of one dimensional problems. Finite Element Analysis of 2-D framed structures.

UNIT:3 [13 Hours]

FEM formulation of 2-D and 3-D stress analysis problems. Jacobian matrix, Axisymmetric solids subjected to axisymmetric loadings. Two-dimensional isoparametric elements

UNIT:4 [10 Hours]

Finite element modeling of fluid flow and heat conduction problems. Exposure to commercial FE codes in ANSYS

Teaching Methods: Chalk & Board

Text Books:

4. Finite Elements in Engineering, T.R.Chandraputla and A.D.Belegundu, PHI.
5. A First Course in the Finite Element Method, D.L.Logan, Cengage Learning

Ref. Books:

1. Introduction to Finite Element Method, J.N.Reddy, Tata McGraw Hill.
2. The Finite Element Method in Engineering, S.S.Rao, Elsevier
3. Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7022	**ADVANCED INTERNAL COMBUSTION ENGINE**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Thermodynamics, Internal Combustion Engine

Course Educational Objectives	
CEO 1	To make students familiar with the design and operating characteristics of modern internal combustion engines
CEO 2	To teach analytical techniques to the engineering problems and performance analysis of internal combustion engines
CEO 3	To teach the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
CEO 4	To introduce students to the environmental and fuel economy challenges facing the internal combustion engine
CEO 5	To introduce students to future internal combustion engine technology and market trends
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand IC Engines through thermodynamic cycles and types of fuel

	induction methods, modern carburetion.
CO2	Evaluate the engine operating parameters, cycle efficiency, torque and performance of carburetor.
CO3	Analyze different fuel induction techniques, Combustion stages, Knocking/ detonation
CO4	Design a modern IC engine with less exhaust emission.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	1	3												1
CO3	2	1												2
CO4		1	2				1							2
Avg.	1.5	1.75	0.5				0.25							1.25

SYLLABUS

UNIT:1 [10 Hours]

Thermodynamic Analysis of I.C.Engine Cycles. Effect of design and operating parameters on Cycle efficiency. Modified fuel-air cycle considering heat losses and valve timing. Engine dynamics and torque analysis. Thermodynamic cycle with supercharging both S.I. and C.I. Engines. Limits of Supercharging. Methods of supercharging and Superchargers.

UNIT:2 [11 Hours]

Fuel of SI and CI engine, Fuel additives, properties, Gaseous fuel for SI and CI engine, LPG, CNG, Mixture requirement at different Load and speed. Principle of Carburetion, Carburetion of air-fuel ratio, Modern carburetor, Scavenging of two stroke engine.

UNIT:3 [12 Hours]

Functional Requirement of Fuel Injection system, Types of Injection, Electronic injection, MPFI, Different types of Nozzles, Injection timing, GDI system, TCI, CDI, firing order, Ignition timing, Spark advance mechanism, Stage of combustion in SI and CI engine, Method to control diesel Knock, Control of Detonation, Methods of measuring pollutants and control of engine emission.

UNIT:4 [12 Hours]

Variable compression ratio engine. Theoretical analysis, methods of obtaining variable compression ratio, Performance of Variable compression ratio Engine, Wankel rotary combustion engine, Stratified charged engine, Methods of charge stratification, Dual fuel and Multifuel engines, Variable Valve timing

engines.
Teaching Methods: Chalk& Board/ PPP/Video Lectures.
Text Books 1. Fundamentals of I.C.Engine by V.Ganeshan, Tata McGraw Hill 2. Fundamentals of I.C. Engines by H.B.Heywood, McGraw Hill 3. I.C.Engine Theory and Practices, Vol.I & II C.F.Taylor, MIT Press
Ref. Books 1. I.C.Engine, Mathur and Sharma, Dhanpat Rai and Sons 2. Fundamental of I.C.Engine by H.N.Gupta, PHI

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7023	**MODERN MANUFACTURING PROCESSES**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Basic Manufacturing process, Machining science and technology						
Course Educational Objectives						
CEO 1	To learn the concepts of material removal using various advanced machining operations					
CEO 2	To develop competency in understanding of machine tools and mechanism involved in machining operations					
CEO	To apply fundamentals principles of electro chemical, laser and plasma					

3	machining
CEO 4	To be able to control surface finish, material removal rate and accurate dimensions by applying different machining operations
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
CO2	Analyze the machining process parameters, and mechanism involved in material removal process in various non conventional machining.
CO3	Interpret contemporary issues in material removal process using advanced techniques, skills and modern engineering tools necessary for engineering practice.
CO4	Apply the concept of concurrent, reversed engineering and rapid prototyping in various industrial applications.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	3	1												
CO3	2	2			1									2
CO4	3	1												
Avg.	2.75	1.5			0.25									0.5

SYLLABUS

UNIT:1 [14 Hours]

ULTRASONIC MACHINING (USM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:-Modelling for finding MRR, Effect of parameters on Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM. Numerical on MRR

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, standoff distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Modelling for finding MRR. Applications, advantages & Disadvantages of AJM. Numerical on MRR.

Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of Water Jet machining.

UNIT:2 [12 Hours]

ELECTROCHEMICAL MACHINING (ECM): Introduction, study of ECM machine, elements of ECM process: ECM Process characteristics – Material removal rate, Accuracy, surface finish, Applications, Electrochemical turning, Grinding, Honing, deburring, Advantages, Limitations. Numerical on MRR

CHEMICAL MACHINING (CHM): Introduction, elements of process, chemical

blanking process, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, electrical discharge grinding, wire EDM

UNIT:3 [12 Hours]

PLASMA ARC MACHINING (PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Applications, Advantages and limitations.

LASER BEAM MACHINING (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

ELECTRON BEAM MACHINING (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM

UNIT:4 [10 Hours]

Introduction to Surface engineering, High speed machining and grinding: Application of advanced coatings in high performance modern cutting tools and high performance super-abrasive grinding wheels, Micro and nano machining of glasses and ceramics. Theory and application of chemical processing: Chemical Machining, Coating and Electro-less forming, PVD and CVD; Introduction to Reverse Engineering, Concurrent Engineering and Rapid prototyping: Solid based, liquid and powder based rapid prototyping methods.

Teaching Methods: Chalk& Board/ PPT/ Lecture by Industry Expert

Text Books:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill 2000
2. Manufacturing Engg. & Technology, Kalpakjian , Pearson Education

Ref. Books:

1. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals.
2. Surface Wear Analysis, Treatment & Prevention - ASM International, Materials Park, OH, U.S.A., 1st Ed. 1995
3. Production Technology, HMT, Tata McGraw Hill. 2001

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7024	**NON DESTRUCTIVE EVALUATION AND TESTING**	**3**	**0**	**0**	**3**	**C**

Pre -Requisite: Machining Science Technology

Course Educational Objectives	
CEO 1	To provide students with a strong knowledge of terms, concepts, principles etc. involved in non-destructive testing.
CEO 2	To provide practical training in handling and testing the non-destructive testing equipments.
CEO 3	To develop knowledge and skills for interpretation and evaluation of the results.
CEO 4	To offer environment to enhance team essential skills for effective careers in the inspection profession

Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand the basic theory and principles of NDT methods.
CO2	Use of appropriate measurement techniques and tools to collect data.
CO3	Interpret the results and investigate the possible artifacts.
CO4	Show confidence to take responsibility for on the job training and guidance of trainees and NDT level I personnel.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													1
CO2	1	2			2									1
CO3	2	2												1
CO4	1				2									2
Avg.	1.5	1			1									1.25

SYLLABUS

UNIT:1 Introduction to NDT, Comparison between destructive and NDT, [6 Hours]

Importance of NDT, Scope of NDT, difficulties of NDT, future progress in NDT, economics aspects of NDT.

Various physical characteristics of materials and their applications in NDT,

Visual inspection – tools, applications and limitations -Fundamentals of visual testing: vision, lighting, material attributes, environmental factors.

UNIT:2 [9 Hours]

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, Developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials , Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism

UNIT:3

[14 Hours]

Principles of MPI, basic physics of magnetism, permeability, flux density,

cohesive force, Magnetizing force, rentivity, residual magnetism, Methods of magnetization, magnetization techniques, Interpretation of MPI, indications, advantage and limitation of MPI.Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT:4 [11 Hours]

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetra meters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

Ref. Books:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7031	**COMPUTATIONAL FLUID DYNAMICS**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Fluid Mechanics, Navier-Stokes Equation,

Course Educational Objectives

CEO 1	To introduce the basics of CFD through FVM,FDM and FEM to students
CEO 2	To teach different discretization scheme to formulate the governing equations.
CEO 3	To make the students understand about fluid flow problem through numerical method (staggering and discretization method) .
CEO 4	To make the students familiar with transient heat transfer problems through finite volume method

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Develop mathematical models for solving fluid flow problems, through one dimensional geometry.
CO2	Analyze the behavior of fluid flow through discretization using ,finite volume method..
CO3	Illustrate and solve the unsteady heat conduction examples using finite volume method.
CO4	Evaluate the transient convection –diffusion problems using different discretization scheme .

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												
CO2	3	1												
CO3	2	3												
CO4	2	3												
Avg.	2.5	2.5												

SYLLABUS

UNIT:1 [14 Hours]

Basics of Computational Fluid Dynamics (CFD)- Introduction to One dimensional computation: Finite difference methods (FDM)-Finite element method(FEM)-Finite volume method(FVM). Solution of Discretised Equations:
The tri-diagonal matrix algorithm (Thomas Algorithm for one dimensional case) The Finite Volume Method for Diffusion Problems-Introduction -Finite volume method for

onedimensional steady state diffusion -Worked examples: one-dimensional steady state Diffusion

UNIT:2 [16 Hours]

The Finite Volume Method for Convection-Diffusion Problems – Introduction - Steady onedimensional convection and diffusion – The central differencing scheme - Assessment of the central differencing scheme for convection-diffusion problems - The upwind differencing scheme - Assessment of the upwind differencing scheme - The hybrid differencing scheme - Assessment of the hybrid differencing scheme - The power-law scheme - Higher order differencing schemes for convection-diffusion problems - Quadratic upwind differencing scheme: the QUICK scheme .

UNIT:3 [10 Hours]

The Finite Volume Method for Unsteady Flows - Introduction - One-dimensional unsteady heat conduction - Explicit scheme - Crank-Nicolson scheme - The fully implicit scheme - Illustrative examples

UNIT:4 [10 Hours]

Implicit method for two- and three-dimensional problems - Discretisation of transient convection-diffusion equation - Worked example of transient convection-diffusion using QUICK differencing..

Teaching Methods: Chalk& Board/Video Lectures

Text Books

1. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, ISBN-10
2. John C. Tannehill, Dale A.Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor &Francis
3. Versteeg, H. K. , Malalasekera W , An Introduction to Computational Fluid Dynamics-The Finite Volume Method, Longman Scientific & Technical.

Ref. Books:

1. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
2. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Norosa Publishing House, N. Delhi

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE7032	**ADDITIVE MANUFACTURING**	**3**	**0**	**0**	**3**	**B**

Pre -Requisite: Basic of Manufacturing processes

Course Educational Objectives

CEO 1	To teach how to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining
CEO 2	To make the students learn the manufacturing of highly complex parts can be an economically viable alternative to conventional manufacturing technologies
CEO 3	To teach type of material used, the deposition technique or by the way the material is fused or solidified
CEO 4	To expose the students to the mathematical models for AM to describe the transport phenomena such as heat/mass transfer and fluid flow

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Explain the importance of AM in Manufacturing
CO2	Able to compare different method and discuss the effects of the Additive Manufacturing technologies
CO3	Analyze the characteristics of the different materials in Additive Manufacturing for social applications
CO4	Elaborate to design a component with Additive Manufacturing technique in the application of Automobile, Aerospace, and Bio-medical etc as well optimize material utilization and elevate the performance.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													

CO2	2													
CO3	2	3				2								
CO4	3		2			2								
Avg.	2.5	0.75	0.5			1								

SYLLABUS

UNIT:1
(12 Hours)
Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications

UNIT:2 (12 Hours)
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 – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT:3 (10 Hours)
LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT:4 (11 Hours)
POWDER BASED ADDITIVE MANUFACTURING SYSTEMS
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 Beam Melting

Teaching Methods: Chalk & Talk/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

Ref. Books

1.Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7033	**MECHANICAL VIBRATION**	**3**	**0**	**0**	**3**	**G**

Pre -Requisite: DOF, SHM, Laplace Transformation

Course Educational Objectives

CEO 1	To teach the importance of vibrations in mechanical design of machine parts that operates in vibratory conditions.
CEO 2	To teach linear vibratory models of dynamic systems with changing complexities (S-DOF and M-DOF).
CEO 3	To derive the differential equation of motion of vibratory systems.
CEO 4	To train the students to analyze on free and forced (harmonic, periodic, non-periodic) vibration system of single and multi degree of freedom linear systems.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Identify the causes and effects of vibration in mechanical systems.
CO2	Develop schematic models for physical systems and formulate governing equations of motion.
CO3	Explain the role of damping, stiffness and inertia in mechanical systems
CO4	Analyze rotating and reciprocating systems and compute critical speeds.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3												2
CO2	3	1	2		1									
CO3	2	1												1
CO4	1	2												2
Avg.	2	1.75	0.5		0.25									1.25

SYLLABUS

UNIT:1 (10 Hours)

Introduction to Mechanical Vibration, Types of Vibration, Simple Harmonic Motion (S.H.M.), Principle of superposition applied to S.H.M., Beats, Fourier analysis, Degree of freedom, Equations of motions, general solution of free vibration.

Undamped free vibration of single degree freedom systems: Modeling of Vibrating Systems, Evaluation of natural frequency – differential equation, Equivalent systems.

UNIT:2 (14 Hours)

Damped free vibration of single degree freedom systems, Different types of damping, Equivalent viscous damping and Structural damping. Study of vibration response of viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement.

Forced vibration of single degree freedom systems, Steady state solution with viscous damping due to harmonic force, reciprocating and rotating unbalance mass, vibration isolation and transmissibility due to harmonic force excitation and support motion.

UNIT:3 (10 Hours) Vibration measuring instruments, Concept of critical speed and its effect on the rotating shaft. Undamped vibration of two degree freedom systems, Free vibration of spring coupled and mass coupled systems, Longitudinal, Torsional and transverse vibration of two degree freedom systems, influence coefficient technique
UNIT:4 (12 Hours) Transverse vibration of strings, longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, whirling of shafts. Introduction, Method of Laplace transformation and response to an impulsive output, response to step-input, pulse-input, and phase plane method
Teaching Methods: Chalk & Board
Text Books: 1. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & company Pvt. Ltd. 3 rd ed., 2006 2. Introductory Course on theory and Practice of Mechanical Vibrations. J.S. Rao & K. Gupta, New Age International Publication, New Delhi, 2007
Ref. Books: 1. Mechanical vibration - By G.K. Grover; Nemchand Chand and Sons 2. Mechanical Vibration – By Thomson; Prentice Hall 3. Mechanical Vibration - By Den Hartog; Mc Graw Hill

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE7034	**TRIBOLOGY**	**3**	**0**	**0**	**3**	**F**

Pre -Requisite: Fluid mechanics

Course Educational Objectives

CEO 1	To expose the student to different types of bearings, bearing materials,
CEO 2	To understand friction characteristics and power losses in journal bearings.
CEO 3	To learn theory and concepts about different types of lubrication.
CEO 4	To learn concept of loss of materials on surfaces and its effects
CEO 5	To design a tribological system with better efficiency

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Rephrase friction characteristics in the field of Tribology
CO2	Summarize about different theories of lubrication to reduce friction and wear
CO3	Analyze the tribological issues in the design of machine components and braking systems
CO4	Evaluate the design a tribological system and estimate optimal performance to develop technical project reports as well technical presentations.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2	2	2												
CO3	2	3												
CO4		2	3											
Avg.	1.5	2	0.75											

SYLLABUS

UNIT:1
(12 Hours)
Introduction to Tribology and Factors influencing Tribological phenomena,

Properties of materials relevant to friction and wear. Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index, determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing
UNIT:2 (12 Hours) Surfaces, Friction and Wear: Surfaces, Friction and Wear: Engineering surfaces - Surface characterization, Contact of engineering surfaces: Hertzian and nonhertzian contact, Contact pressure and deformation in non-conformal contacts. Causes of friction, Stick-slip friction behaviour and friction instability, sliding and rolling friction, frictional heating and temperature rise, Friction measurement techniques. Wear and wear types, Mechanisms of wear, Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear measurement and controlling techniques.
UNIT:3 (8 Hours) Lubrication: Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing
UNIT:4 (8 Hours) Design of Tribological Elements: Tribological consideration in design, Mechanisms of tribological failures in machines, Design Hydrodynamic bearings, and Performance analysis of gears, seals, piston rings, machine tool slide ways, cams and follower. Surface Engineering for Wear and Corrosion resistance: Diffusion, coating, electro and electro-less plating, hot deep coating, metal spraying, cladded coating, crystallizing coating, selection of coating for wear and corrosion resistance, potential properties and parameters of coating
Teaching Methods: Chalk& Talk/ PPT/Video Lectures/Lecture by Industry Expert
Text Books 1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI 2. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co
Ref. Books 1. Tribology – B.C. Majumdar, Tata McGraw Hill Co Ltd

2. Lubrication - Raymono O. Gunther; Bailey, Bros & Swinfan Ltd.
3. Bearing Systems - Principles and Practice, PT Barwll
4. Dowson D, History of Tribology, Longman London, 1979.
5. Stachowiak G N,Batchelor A W and Stachowick G B "Experimental methods in Tribology", Tribology Series 44, Editor D Dowson, 2004.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7041	**DESIGN AND ANALYSIS OF HEAT EXCHANGER**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Thermodynamics, Heat Transfer, Design of machine elements

Course Educational Objectives

CEO 1	To know common heat exchanger types, their advantages and limitations.
CEO 2	To learn how to handle rating and sizing problems in heat exchanger design
CEO 3	To analyze various types of heat exchangers providing heat transfer between two or more fluids and acquiring necessary information for the design of heat exchangers.
CEO 4	To examine how to consider fouling of surfaces, incorporate fouling in designs, and handle fouling during heat exchanger operation.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand different types of flow, heat exchanger & mechanism of

	heat exchange.
CO2	Analyze the effectiveness of LMTD approach over AMTD approach based on different factors
CO3	Evaluate the effectiveness of different heat exchangers
CO4	Design and develop Heat Exchangers with different applications along with allied equipments.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												1
CO2	2	3												
CO3	1	3												
CO4		2	3											2
Avg.	1.25	2.25	0.75											0.75

SYLLABUS

UNIT:1 (12 Hours)

Heat exchanger types, constructional details, Nature of heat exchange, Parallel flow, Counter flow, Cross flow, Concentric tube, Shell and tube, Multiple shell and tube, Compact heat exchanger, Condenser, Evaporator, Regenerator, Recuperator . Overall heat transfer coefficient, Thermal resistance, Efficiency. Temperature Distribution and its implications

UNIT:2 (12 Hours)

LMTD, effectiveness, Overall Heat transfer coefficients, Fouling factor, Scaling factor, Correction factor, NTU method, Flow Distribution, Friction Factor, Pressure Loss, Pumping power, Orifice, Flow nozzle, Diffusers, Bends, Baffles, Effect of Channel Divergence, Manifolds.

UNIT:3 (14 Hours) Heat exchanger fabrication, Tubular versus flat plate, Tube to header joint, Finned surface, Design of Liquid to Liquid heat exchanger, Plate and Frame heat exchanger, Design of Gas to Gas heat exchanger, Tubular regenerators for gas turbine, Regenerator for mobile gas turbine, Recuperators for heat pipe, Design of Liquid to gas heat exchanger, Comparison of fin geometric, Design of fin matrices, Design of automotive radiators.
UNIT:4 (10 Hours) Stress in tubes, Headers sets and Pressure vessels: Differential Thermal Expansion, Thermal stresses, Shear stresses, Thermal sleeves, Vibration, Noise, types of failures. Design Aspects: Heat transfer and pressure loss flow configuration effect of baffles. Effect of deviations from ideality. Design of cooling towers. Types of cooling tower, Wind loads, Dry cooling tower.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures by Industry Expert & Academia
Text Books 1. Heat and Mass Transfer by P.K. Nag, TMH 2. A.P. Frass and M.N.Ozisik, Heat Exchanger Design',John Wiley & Sons Inc, 1965.
Ref. Books 1. W.M. Kays and A.L. London.Compact Heat Exchangers', 3rd Ed., TMH,1984. 2. G.Walker, Industrial Heat Exchangers', A basic guide, TMH V Book Co., 1980.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7042	FIRE AND SAFETY ENGINEERING	3	0	0	3	A

Pre -Requisite: Basics on Fire Safety

Course Educational Objectives

CEO 1	Practice fire protection engineering technology regionally, nationally, and internationally in a broad range of modern professional settings.
CEO 2	Actively participate in the development of engineering technology decisions on societal, environmental, economical, and safety issues at the local or global levels.
CEO 3	Learn various uses of fire protective equipments in industries.
CEO 4	Indentify various risks and hazards to develop safe work systems.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Discuss fire dynamics, fire initiation, Combustion effects and classification of various fire fighting equipments.
CO2	Examine building regulations and fire engineering principles and their application to fire engineered alternative solutions.
CO3	Explain active and passive fire safety systems and their application.
CO4	Apply knowledge of the practical design process adopted by the industry

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2						2							1
CO2			2			2								
CO3	1					1								2
CO4			2				2							1
Avg.	0.75		1			0.75	1							1

SYLLABUS

UNIT 1:
[13 Hours]
Basic Physics and chemistry related to fire, Anatomy of Fire, Classification of Fire

& Extinguishers, Pumps and primers, Foam and foam making equipments
UNIT 2 : [10 Hours] Hose and hose fittings, Water relay systems, breathing apparatus, Small gears
UNIT 3 : [12 Hours] Fire protective clothing, Ladders, Ropes and lines, bends & hitches, Fire prevention, Special appliances, Fire fighting codes and standards, Electrical fire hazards, Structures under Fire.
UNIT 4: [12 Hours] Safety goals and objectives, Monitoring safety progress, Identifying hazards and risks, Safety and financial benefits, Safety and the balanced scorecard, Setting targets and ensuring commitment, Developing safe work systems, Policies and procedures, Safety values and Principles
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert
Text Books: 1. Principles of Fire Safety Engineering: Understanding Fire and Fire Protection: Akhil Kumar Das, PHI learning private limited 2014 2. A Guide to Fire Safety Engineering: S. D. Christian, BSI British Standards Institution, 2010.
Ref. Books: 1. Fire from First Principles: A Design Guide to Building Fire Safety: John Abrahams, Dr Paul Stollard, Paul Stollard 2. Fire Risk: Fire Safety Law and Its Practical Application: Allan Grice Thorogood Publishing, 2009.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE7043	**ROBOTICS AND ROBOT APPLICATION**	**3**	**0**	**0**	**3**	**G**

Pre -Requisite: Basic knowledge of mathematics

Course Educational Objectives

CEO 1	To make the students understand the concept, development and key components of Robots.
CEO 2	To teach how to analyze and solve problems related to direct kinematics and inverse kinematics.
CEO 3	To teach the various robot sensors and Actuators that enables a robot to function for a specified task.
CEO 4	To teach how to apply techniques to import automation lines in manufacturing industries for mass production.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Define components of robots and their functions
CO2	Analyze and solve problems in spatial coordinate representation and spatial transformation by kinematic principles for motion control.
CO3	Apply dynamic principles for different manipulators.
CO4	Choosing various sensors and Actuators that enable a robot in Manufacturing.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													2
CO2	1	3												
CO3	2	2												
CO4	3													2

Avg.	2.25	1.5												1

SYLLABUS

UNIT:1 [14 Hours]

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT:2 [12 Hours]

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Manipulator Kinematics: H notation H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

UNIT:3 [12 Hours]

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

UNIT:4 [10 Hours]

Robot actuators and Feedback components:Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparisons of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.Robot Application in Manufacturing:Material Transfer - Material handling, loading and unloading-Processing - spot and continuous arc welding & spray painting - Assembly and Inspection

Teaching Methods: Chalk& Board/ PPT/Video Lectures.

Text Books:

1. Industrial Robotics by Groover M P /Pearson Edu.
2. Robotics by Fu K S/ McGraw Hill.

Ref. Books:

1. Robotics and Control / Mittal R K & Nagrath I J / TMH.
2. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
3. Robot Analysis and control Asada and Slotine / Wiley Inter-Science

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE7044	**NANO SCIENCE**	**3**	**0**	**0**	**3**	**E**
Pre -Requisite: Engineering Physics, Engg. Chemistry, IPMEM.						
Course Educational Objectives						
CEO 1	To learn the basic science behind the properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.					
CEO 2	To teach a knowledge on the state-of-the-art of nano-fabrication methods					
CEO 3	To know the fundamental principles of nanoscience and its application to engineering.					
CEO 4	To demonstrate the use of various testing tools that are used in production/synthesis and research/analysis of nano-structured materials					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						
CO1	Define the basic science behind the properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nano materials.					
CO2	Demonstrate a comprehensive understanding of state-of-the-art on nano-fabrication methods.					

CO3	Analyze the characterization of nano materials by using different testing tools.
CO4	Discuss various applications of Nano materials in societal field.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2	2	2												
CO3	2	2			1									
CO4	3						2							
Avg.	2.25	1.25			0.25		0.5							

SYLLABUS

UNIT:1 [9 Hours]

Introduction: History and Scope, Implications for Physics, Chemistry, Biology and Engineering, Classifications of nanostructured materials- nano particles-quantum dots, nanowires-ultra-thinfilms-multilayered materials, Applications of Nanomaterials.

Effect of Nano-dimensions on Materials Behavior: Mechanical properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility, Optical, Magnetic Properties.

UNIT:2 [12 Hours]

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly, Top down approaches: Mechanical alloying, Nano-lithography, Consolidation of Nanopowders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT:3
[12 Hours]
Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM). Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT:4
[12 Hours]
Applications of Nanomaterials: Information storage- nanocomputer, molecular switch, super chip, Nano-electronics, Micro- and Nano-electro-mechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Textiles, Paints, Energy, Defence and Space Applications, Photostat, printing, solar cell, battery.

Teaching Methods: Chalk& Talk, Ppt ,video lecture.

Text Books:

1. Nano: The Essentials by T.Pradeep, Mc Graw- Hill Education.
2. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

Ref. Books:

1. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000
2. Akhlesh Lakhtakia (Editor),"The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000.

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP
BMEPC7110	INDUSTRIAL ENGINEERING LABORATORY	0	0	2	1	

Pre -Requisite: Mechanical Measurement, Industrial Engineering

Course Educational Objectives

CEO1	To teach process of calibration and experimentation with different measuring devices.
CEO2	To improve the location selection ability and layout design through different quantitative techniques.
CEO3	To develop a stores management skill based on different criteria.
CEO4	To educate the modern IT tools used in different industries for the optimum utilization of resources

Course Outcomes: Upon successful completion of this course, students should

CO1	Outline the methods to calibrate different property measurement instruments.
CO2	Experiment with pneumatic trainer and hydraulic trainer.
CO3	Analyze the data for optimum location selection, layout design, work sampling and inventory management.
CO4	Adapt modern IT tools for solving complex problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				2										
CO2				2										
CO3				3										
CO4				2	2									
Avg				2.25	0.5									

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)
1.Calibration of LVDT using indicator / CRO
2. Calibration of load cell using electrical resistance strain gauge
3. Calibration of thermo couples
4. Experiment on Pneumatic trainer
5. Experiment on Hydraulic trainer
6. Do Work Sampling of any work situation and determine how much time is spent in value addition, inspection /checking, communication and idleness.
7. Collect layout of any industry/ institute and design layout of similar industry/ institute to be constructed on a different site.
8. Select two or more possible locations for setting up of an industry/ institute and do comparative evaluation with respect to different parameters.
9. Gather sample data about stock of different items, their consumption pattern and price from any one of the following business firms such as Automobile Repair Shop, Medicine Store, Consumer Store, Production Shop, Service Centre etc and suggest stock that should be maintained for optimizing Inventory.
10. Hands on practice on any Manufacturing Execution System (MES) software/ ERP suit such as NetSuite Manufacturing, IQMS MES Software, Fishbowl Manufacturing, JobBOSS, MES SIMATIC IT, etc.

VIII SEMESTER [FOURTH YEAR]

S.No	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PE	BMEPE8011	Power Plant Engineering	3	0	0	3	A
		BMEPE8012	Reverse Engineering					B
		BMEPE8013	Product design & product tooling					A
		BMEPE8014	Advanced computer graphics and solid Modelling					G
2	PE	BMEPE8021	Composite materials	3	0	0	3	G
		BMEPE8022	Computer Integrated manufacturing					C
		BMEPE8023	Cryogenics					A
		BMEPE8024	Gas Turbine & Jet Propulsion					A
3	OE	B**OE8031	Open Elective-IV *(Any One)*	3	0	0	3	A
		B**OE8032						
		B**OE8033						
		B**OE8034						
PRACTICAL / SESSIONAL								
4	PC	BMEPC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	12	6	
5	PC	BMEPC8180	Seminar and Technical Writing	0	0	4	2	
6	PC	BMEPC8190	Comprehensive Viva-Voce	0	0	4	2	
		TOTAL:		**9**	**0**	**20**	**19**	

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P

BMEPE8011	POWER PLANT ENGINEERING	3	0	0	3	A

Pre -Requisite: Engineering Thermodynamics, Fluid Mechanics

Course Educational Objectives

CEO 1	To teach principles of thermodynamics, fluid mechanics, and heat transfer to the design and analysis of thermo dynamical systems by considering the environmental issues
CEO 2	To make the student aware of the relevance of environmental different power plants
CEO 3	To teach about the power plant overall issues on practical field
CEO 4	To teach the concept of sources of energy and their optimum utilization

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand and analyze the working principle of the components of nuclear, thermal and oil based power plant.
CO2	Evaluate the performance of nozzle, turbines and economics of power plant.
CO3	Apply safety measures and pollution control technologies to coal and nuclear power plant
CO4	Compare and solve power tariffs and costs.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	2	3												
CO3	2						3							
CO4	2	3												
Avg.	2.25	1.75					0.75							

SYLLABUS

UNIT:1 [10 Hours]

Introduction to power plants and boilers Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection , Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidised Bed Boilers Fuel and ash handling , Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught-Different Types, Condenser types, cooling Towers

UNIT:2 [14 Hours]

Flow Through Nozzles Types of nozzles and their area of application & related calculation, critical pressure & Chocked flow, super saturated flow. Effect of friction and nozzle efficiency Steam turbines Turbine types, Variation of Pressure and Velocity in different types of turbines, Simple impulse Turbines,

Flow through turbine blades and velocity diagram, Pressure -compounded impulse turbines and Velocity compounded impulse turbines. Turbine power and related calculations.
UNIT:3 [12 Hours] Nuclear power plants Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants
UNIT:4 [10 Hours] Energy, economic and environmental issues of power plants Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants
Teaching Methods: Chalk& Board/ Presentation/Video Lectures/Lecture by Industry Expert/Industrial tour
Text Books: 1. Power Plant Engineering, P K Nag. Tata McGraw- Hill ,2007 2. El-Wakil M.M ,Power "Plant Technology," Tata McGraw-Hill 1984
Ref. Books: 1. Power plant Engineering , R K Rajput, LAXMI Publication 2. K.K.Ramalingam , " Power Plant Engineering ", Scitech Publications, 2002 3. G.R,Nagpal , "Power Plant Engineering", Khanna Publishers 1998

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE8012	**REVERSE ENGINEERING**	**3**	**0**	**0**	**3**	**B**

Pre -Requisite: Basics of CAD and CAM

Course Educational Objectives

CEO 1	To the basic fundamentals of CAD/ CAM, and CAD Designing for its applications in manufacturing systems.
CEO 2	The History of Reverse Engineering, Scope and phases of reverse engineering.
CEO 3	The various Methodologies and techniques of reverse engineering
CEO 4	Rapid prototyping technique and the Project Implementation by Equipment's Involved for Reverse Engineering techniques.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	List the principles involved in manufacturing process by reverse engineering techniques.
CO2	Compare and exploit the capabilities of a particular data acquisition technique to generate accurate digital models
CO3	Analyze various Methodologies and techniques of reverse engineering.
CO4	Propose various rapid prototyping techniques and materials for Project Implementation.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													1
CO2	3	2												
CO3	2													
CO4	3	3												2
Avg.	2.75	1.25												0.75

SYLLABUS

UNIT:1 [10 Hours]

Fundamentals of Manufacturing; Types of production function in manufacturing; Fundamentals of CAD/ CAM, CAD Designing: Design process, Applications of computer for design, Creating the Manufacturing Database. Constructing the Geometry, Transformations of geometry, Database structure and content, Wire frame versus solid modeling, Constraint– Based modeling, Geometric commands, Display control commands, Editing, Model

preparation, Slicing, Support structures and machine instructions
UNIT:2 [10 Hours] History of Reverse Engineering, Scope and tasks of RE, Reverse engineering process-Three phases of reverse engineering-Phase I: Scanning, Phase II: Point processing, Phase III: Geometric model development, Technical Data Generation, Evaluation and Verification ,Case studies. STL Files: Process overviews, STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. STL file Generation, File Verification & Repair, Build File Creation, and Part Construction, STL file generation, Defects in STL files and repairing algorithms.
UNIT:3 [8 Hours] Methodologies and techniques of reverse engineering: Computer aided reverse engineering, Computer vision and reverse engineering, Structured light range imaging, Scanner pipeline, case studies. Reverse engineering hardware, Reverse engineering software, Selection of a reverse engineering system, Case studies with implementation
UNIT:4 [12 Hours] Introduction to rapid prototyping: Basic process, Current techniques and materials, Applications, Relationship between reverse engineering and rapid prototyping, Case studies with implementation.Project Implementation, Equipment Involved in the Reverse Engineering technique, Domain analysis-process of duplicating Applications and case studies. Cognitive approach to program understated, Integrating formal and structured methods in reverse engineering, Integrating reverse engineering, reuse and specification tool environments to Rapid Prototyping, Interdisciplinary Application of RP and RE
Teaching Methods: Chalk& Board/ Chalk& Board/PPT/Guest lecturers/NPTEL videos/Industry Experts
Text Books: 6. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991 7. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
Ref. Books: 17. Bjorke, Layer Manufacturing, Tapir Publisher. 18. Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs, 1992 19. Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, 1993

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE8013	**PRODUCT DESIGN & PRODUCT TOOLING**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Basic Manufacturing, Manufacturing science Technology, Project Management

Course Educational Objectives

CEO 1	To study the basic concepts of product design and development process.
CEO 2	To study the applicability of product design and development in industrial applications.
CEO 3	To design dies for different forging operation and sheet metal working.
CEO 4	To study various locating and clamping methods as well as design jigs and fixtures

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Interpret the concept of product design and product development.
CO2	Apply principles of locating and clamping systems for designing jigs and fixtures.
CO3	Select and design forging dies as well as progressive, compound or combination dies for sheet metal workings.
CO4	Design Single point cutting tool, form tools and tooling for turret lathe and automats

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	3											
CO2	1	1	2											
CO3	1	2	3											
CO4	1	2	3											1
Avg.	1.25	1.5	2.75											0.5

SYLLABUS

UNIT:1 [12 Hours] Product design, product design considerations, product development, product life cycle, value analysis and value engineering, product specification. Role of computer in product design. Process Planning – selection of processes, Design of sequence of operations, Time & cost estimation
UNIT:2 [14 Hours] Forging design: allowances, die design for drop forging, upset forging die design, design of flash and gutter. Sheet metal working: Design consideration for shearing, blanking piercing, deep drawing operation, progressive and compound die, strippers , stops, strip layout.
UNIT:3 [10 Hours] Design of jigs and fixtures, principle of location and clamping, clamping methods, locating methods, Drill Jig bushing, Indexing type drilling Jig.
UNIT:4 [10 Hours] Design of single point cutting tool, broach and form tool design. Tooling design for turret lathe and automats
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lecture
Text Books: 1. Manufacturing Technology, P.N. Rao , Tata McGraw Hill 2. A Textbook of Production Engineering, P.C. Sharma, S. Chand & Co
Ref. Books: 1. Product Design & Manufacturing, A K Chitale, R C Gupta, Eastern Economy Edition, PHI. 2. Technology of Machine Tools, Krar, Gill, Smid, Tata Mc Graw Hill 3. Jigs & Fixture Design, Edwrd G Hoffman, Cengae Learning

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE8014	**ADVANCED COMPUTER GRAPHICS AND SOLID MODELING**	**3**	**0**	**0**	**3**	**G**

Pre -Requisite: Basic Mathematics

Course Educational Objectives

CEO 1	To teach recent research in Computer Graphics, Modeling Geometry, Interactive Techniques, and Visualization.
CEO 2	To teach design 3D modeling transformation and viewing. the graphics pipeline and an interactive render loop.
CEO 3	To make the students eligible to develop and implement efficient and accurate surface modeling and solid geometry.
CEO 4	To teach how to develop and demonstrate programming skills in 3D computer graphics..

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand graphics primitives and work with coordinate spaces, coordinate conversion, and transformations of graphics objects.
CO2	Analyse line, circle, ellipse and character generation algorithms.
CO3	Explain various 3D projections and current models for curves and surfaces.
CO4	Apply appropriate techniques and by using modern tools, to generate & analyse 3D solid models in order to solve Mechanical Engineering problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												

CO2	2	3												
CO3	3	1												
CO4	2	3			1									
Avg.	2.5	2			0.25									

SYLLABUS

UNIT:1 [10 Hours]

Introduction: Computer I/O devices- Video display devices- Refresh CRT - Raster scan display - Color CRT monitor - Co-ordinate representation - Ggraphic displays in engineering workstations - 2D graphics Transformations- 3D geometry, primitives and transformations.

UNIT:2 [8 Hours]

Basic raster graphics algorithm for drawing 2D primitive - Output characteristics: Aspect ratio - Line drawing algorithm - DDA algorithm - Circle generation algorithm - Mid point circle algorithm - Ellipse generation algorithm.

UNIT:3 [10 Hours]

Classification of Geometric Modeling - Wire frame, Surface and Solid Modeling, applications -representation of curves and surfaces - Parametric form - Design of curved shapes- Cubic spline - Bezier curve - B-spline curve - Design of Surfaces - features of Surface Modeling

UNIT:4 [10 Hours]

Introduction to 3-D modelling - Generation of various 3D Models through Protrusion - revolve, shell sweep - Creation of various features - Study of parent child relationships - Feature based and Boolean based modeling - Constructive solid geometry. Standards for computer graphics (GKS) and Data exchange standards: IGES, STEP - Data structures for Entity storage - Data structures for interactive modeling.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books

1. Saxena, A., Sahay, B., Computer Aided Engineering Design, Springer, 2005
2. Computer Graphics, D. Hearn and M.P. Baker (C Version), Pearson Education

Ref. Books

1. Anand, V. B., Computer and Geometric Modeling for Engineers, John Wiley & Sons.
2. Hoffmann, C.M., Geometric & Solid Modeling, An Introduction, Morgan Kaufman.
3. Computer Graphics, Z. Xiang, R. A. Plastock, Schaum's Outlines, McGrow Hill

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE8021	**COMPOSITE MATERIALS**	**3**	**0**	**0**	**3**	**G**

Pre -Requisite: Introduction to Physical Metallurgy

Course Educational Objectives

CEO 1	To teach basic concept of composites and their classification
CEO 2	To extend a knowledge of applications and selection of different composites in consideration of the properties and characteristics to students
CEO 3	To teach the manufacturing processes of reinforcement fibers and volume fraction effect on matrices of composites
CEO 4	To teach the concept of tailored design philosophy

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Illustrate the concept of composite and Predict elastic properties of long fiber and short fiber composites.
CO2	Explain fundamental fabrication processes for polymer matrix, metal matrix, and ceramic matrix composites
CO3	Analyze the strengthening mechanism and structural effect on properties of composite materials for societal application
CO4	Design different types of composite by apply the micromechanics principles.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES	PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	2												3	
CO3	2					2							2	
CO4	1		3										1	
Avg.	2		0.75			0.5							2	

SYLLABUS

UNIT:1
[16 Hours]
Introduction: definitions and classifications; natural composites; role of matrix and reinforcement; factors which determine properties; the benefits of composites.
Reinforcements and the reinforcement matrix interface: natural fibers; synthetic organic fibers – aramid, polyethylene; and synthetic inorganic fibers – glass, alumina, boron, carbon, silicon based fibers; particulate and whisker reinforcements, reinforcement-matrix interface – wettability, interfacial bonding, and methods for measuring bond strength

UNIT:2
[12 Hours]
Metal matrix composites: Introduction, important metallic matrices; metal matrix composite processing: solid state processing – diffusion bonding, powder metallurgy; liquid state processing – melt stirring, compocasting (rheocasting), squeeze casting, liquid infiltration under gas pressure; deposition – spray co-deposition and other deposition techniques like CVD and PVD; in situ processes. Interface reactions.
Properties of MMCs – physical properties; mechanical properties like elastic properties, room temperature strength and ductility, properties at elevated temperatures, fatigue resistance. Processing, structure of multi-filamentary superconductors, properties of aluminium reinforced with silicon carbide particles.

UNIT:3 [12 Hours]
Ceramic matrix composites: Introduction; processing and structure of monolithic materials – technical ceramics, glass-ceramics. Processing of ceramics: conventional mixing and pressing – cold pressing and sintering, hot pressing, reaction bonding processes, techniques involving slurries, liquid state processing – matrix transfer moulding, liquid infiltration, sol-gel processing, vapour deposition techniques like CVD, CVI, liquid phase sintering, lanxide process and in situ processes. Processing, properties and applications of alumina matrix composites - SiC whisker reinforced, zirconia toughened alumina; Glass-ceramic matrix composites; Carbon-carbon composites - porous carbon-

UNIT:4 [10 Hours]
Polymer matrix composites: Introduction; polymer matrices – thermosetting,

thermoplastic, rubbers. Processing of PMCs, Processing, properties and applications of fibre-reinforced epoxies, PEEK matrix composites, rubber matrix composites. Damping characteristics. Environmental effects in polymer matrix composites. Recycling of PMCs. Micromechanics of unidirectional composites: micromechanics models for stiffness – longitudinal stiffness, transverse stiffness, shear modulus, poisson's ratio.
Teaching Methods: Chalk& Board
Text Books: 1.Composite Materials: Engineering and Science, by Matthews and Rawlings, CRC Press. 2.Composite Materials Science and Engineering, K.K.Chawla, SpringerAn Introduction to composite material, by D.Hull and T.W. Clyne, Cambridge University press. 3.Metal Matrix Composites, Thermomechanical Behaviour by M.Taya, and R.J.Arsenault, Pergamon Press, Oxford. 4.Fundamentals of Metal Matrix Composites by S.Suresh, A.Martensen, and A.Needleman, Butterworth, Heinemann
Ref. Books: 1. An Introduction to composite material, by D.Hull and T.W. Clyne, Cambridge University press. 2. Metal Matrix Composites, Thermomechanical Behaviour by M.Taya, and R.J.Arsenault, Pergamon Press, Oxford. 3. Fundamentals of Metal Matrix Composites by S.Suresh, A.Martensen, and A.Needleman, Butterworth, Heinemann

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEPE8022	**COMPUTER INTEGRATED MANUFACTURING**	**3**	**0**	**0**	**3**	**C**
Pre -Requisite: CAD/CAM						
Course Educational Objectives						
CEO 1	To teach the basic components of CIM and its hardware and software					
CEO 2	Introduce students to basics of Industrial robotics and programmable logic controllers					
CEO 3	The integration of manufacturing activities into a complete system					
CEO 4	FMS and its applications					
Course Outcomes: *Upon successful completion of this course, students should be able to:*						

CO1	Outline the effect of manufacturing automation strategies and derive mathematical models for production rate.
CO2	Apply principles of robot programming for executing different function in robotics and PLC programming for networking related problem solving
CO3	Categorize production flow with some manufacturing systems like group technology, cellular manufacturing etc.
CO4	Design a FMS or CIM system for any production system

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2	1	2												
CO3	2	1												
CO4	2	2	3											
Avg.	1.75	1.5	0.75											

SYLLABUS

UNIT:1 [12 Hours]

Fundamentals of Manufacturing and Automation: Production systems, automation principles and its strategies; Types of production function in manufacturing; Automation principles and strategies, automation functions and level of automation; product/production relationship, Production concept and mathematical models for production rate, capacity, utilization and availability; Cost -benefit analysis. Computer Integrated Manufacturing: Basics of product design, CAD/CAM, Concurrent engineering, CAPP and CIM

UNIT:2 [14 Hours]

Industrial Robotics: Robot anatomy, control systems, end effectors, sensors and actuators; fundamentals of NC technology, CNC, DNC, NC part programming; Robotic programming, Robotic languages, work cell control, Robot cleft design, types of robot application, Processing operations, Programmable Logic controllers: Parts of PLC, Operation and application of PLC, Fundamentals of Net workings; Material Handling, automated storage and retrieval systems, automatic data capture, identification methods, bar code and other technologies.

UNIT:3 [10 Hours]

Introduction to manufacturing systems: Group Technology and cellular manufacturing, Part families, Part classification and coding, Production flow analysis, Machine cell design, Applications and Benefits of Group Technology

UNIT:4 [10 Hours]

Flexible Manufacturing system: Basics of FMS, components of FMS, FMS planning and implementation, flexibility, quantitative analysis of flexibility, application and benefits of FMS. Computer Aided Quality Control: objectives of CAQC, QC and CIM, CMM and Flexible Inspection systems

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industrial Expert

Text Books:
1. Automation, Production Systems and Computer Integrated Manufacturing: M.P.
Groover, Pearson Publication.
2. Automation, Production systems & Computer Integrated Manufacturing, M.P Groover, PHI
3. Scheer.A.W., 'CIM- Towards the factory of the future' Springer -Verlag,
4. Ranky Paul. G., 'Computer Integrated Manufacturing', Prentice Hall International

Ref. Books:
1. CAD/CAM Theory and Practice, Zeid and Subramanian, TMH Publication
2. CAD/CAM Theory and Concepts, K. Sareen and C. Grewal, S Chand publication
3. Computer Aided Design and Manufacturing, L. Narayan, M. Rao and S. Sarkar, PHI
4. Klafter, R.D., Chmielewski, T.A., and Negin. M, Robot Engineering-An Integrated Approach, Prentice Hall of India, New Delhi,

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE8023	**CRYOGENICS**	**3**	**0**	**0**	**3**	**A**
Pre -Requisite: Fundamentals of Thermodynamics, Physical Metallurgy & Refrigeration Engineering						
Course Educational Objectives						
CEO 1	To familiar with the classification of physics properties of materials at cryogenics parameters.					
CEO 2	To make the student understand how to apply cryogenic treatments and cryogenic insulations in the technical application.					
CEO 3	To teach the design and analysis the Characterization of cryogenically processed materials.					

CEO 4	To familiar with the evaluation& preparation of cryogenic processing of materials for different applications in the real world with a consideration for environmental hazards.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Summarize the physics properties of materials at cryogenics parameters and gas liquefaction systems.
CO2	Apply cryogenic treatments and cryogenic insulations in the technical application.
CO3	Design and analyze the Characterization of cryogenically processed materials
CO4	Evaluate Cryogenic processing of materials for different applications in the real world with a consideration for environmental hazards.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	2	3												
CO3		2	3											
CO4	2	2												
Avg.	1.75	2	0.75											

SYLLABUS

UNIT:1 [10 Hours]

Properties of engineering materials at cryogenic temperatures, mechanical properties thermal properties, electric & magnetic properties, super conducting materials ,thermo electric materials, composite materials, properties of cryogenic fluids, super fluidity of He3 &He4. Measurement systems for low temperatures:-Temperature measurements, pressure measurements, flow measurements, liquid level measurements, fluid quality measurements

UNIT:2 [13 Hours]

Gas Liquification Systems:-Liquefaction systems for Air Simple Linde –Hampson System, Claude System, Heylndt System, Dual pressure, Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components of liquefaction systems.
Gas Cycle Cryogenic Refrigeration Systems:-Classification of Cryo coolers Stirling cycle Cryo – refrigerators, Ideal cycle – working principle. Schmidt's analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirlingcryo-cooler, Free displacer split type StirlingCryo coolers, Gifford McmahonCryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.

UNIT:3

[12 Hours]

Cryogenic insulation&Vacuum Technology: -Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping, Measurement of high vacuum level. Cryogenic Insulation: Heat transfer due to conduction, Evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation.

Desirable qualities for materials used in cryogenic applications, History and applications of metallic / non-metallic materials, Understanding properties and fabrication processes of superconducting Nb3Sn wires, High temperature superconductors. Characterization of cryogenically processed materials

UNIT:4 [10 Hours]

Cryogenic processing of materials for Space applications, Superconductivity, Medical applications, Food Preservation-Individual Quick Freezing, Tool Industry, Automobiles etc.Hazards:-Physical hazards, Chemical hazards, Physiological hazards, combustion hazards, oxygen hazards.Safety in handling of cryogens, care for storage of gaseous cylinders, accidents in cryogenic plants & prevention.

Teaching Methods: Chalk& Board, PPT, Video Lectures

Text Books:

1.Randall F. Barron, "Cryogenic Systems", McGraw-Hill, 1985.
2.William E. Bryson, "Cryogenics", HanserGardner Publications,1999.

Ref. Books:

1. Scott R. B., "Cryogenic Engineering", Van Nostrand and Co., 1962.
2. Jha, A. R., "Cryogenic Technology and Applications", Butterworth-Heinemann, 2006.

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	Q P
BMEPE 8024	GAS TURBINE & JET PROPULSION	3	0	0	3	A

Pre -Requisite: Thermodynamics ,fluid mechanics and Mathematics

Course Educational Objectives

CEO	To teach gas turbine cycle (Brayton) and know the working principle of

1	each component of gas turbine engine
CEO 2	To make the students about the application of shaft power in gas dynamics , compressibility effects, normal shock wave and oblique shock wave
CEO 3	To teach about the design of combustion chamber and performance characteristics curve
CEO 4	To aware the students about the application of axial flow turbine ,turbojet, turbo prop, turbo fan, ram jet, pulse jet engine
Course Outcomes: *Upon successful completion of this course, students should be able to:*	
CO1	Understand the concept of Brayton cycle, compressors, one and three dimensional flow, combustion theory, turbo machines etc.
CO2	Solve problems on Brayton cycle, one /three dimensional flow, gas dynamics, combustion chamber, centrifugal and axial compressors/turbines.
CO3	Design and evaluate the performance of turbine blades, combustion chamber, turbine stages
CO4	Develop turbo machineries with high performance.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1												
CO2	1	3												
CO3		2	3											
CO4	1		2											3
Avg.	1.25	1.5	1.25											0.75

SYLLABUS

UNIT:1 [10 Hours]

Bray ton cycle, regeneration and reheating cycle analysis , Axial flow fans and compressors, Elementary theory, degree of reaction , three dimensional flow, simple design methods, blade design, calculation of stage performance, overall performance.

UNIT:2 [12 Hours]

Introduction of gas dynamics – Compressibility effect, steady state one dimensional compressible flow of a perfect gas in a duct, isentropic flow in a constant area duct with friction, normal shock waves, oblique shock wave, supersonic expansion and compression.

UNIT:3 [10 Hours]

Combustion: Performance characteristics. Combustion system, Form of combustion, important factors affecting combustion chamber design, combustion processes, combustion chamber performance, practical problem

UNIT:4 [14 Hours]

Axial flow turbines, construction of centrifugal and axial flow turbine, Analysis of Turbo Jet, Turbo Prop, Turbo Fan, Ram Jet, Pulse Jet Engine. Centrifugal fans Blowers and Compressors, Principle of operations, work done and pressure rise, slip factor, surging, chocking, Stalling
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert
Text Books: 1. Rarefied Gas Dynamics: From Basic Concepts to Actual Calculations Volume 21 of Cambridge Texts in Applied Mathematics Rarefied Gas Dynamics: From Basic Concepts to Actual CalculationsCarlo Cercignani 2. Fundamentals of Gas Turbine by V.Ganeshan, Tata McGraw Hill 3. Internal Combustion Engine, R K Rajput, Laxmi Publication
Ref. Books: 1. J.E Lee, Theory and design of stream and gas turbine, TMH Publication 2. Gas Turbines, Cohen & Rogers, Longmans Green Publisher

OPEN ELECTIVES

LIST OF SUBJECTS OPTED FOR OPEN ELECTIVE			
Biology for Engineering	Micro Biology	Environmental Biotechnology	Food Biotechnology
Genetic Engineering	Bioinformatics	Nano Biotechnology	Biostatistics
Fundamentals of Biotechnology	Plant Biotechnology	Biosensors and Diagnostics	Fermentation Technology
Upstream Process Engineering	Biochemical Reaction Engineering	Fuel and Energy Technology	Integrated Solid Waste Management
Basic Chemical Engineering	Novel Separation Techniques	Green Technology	Pollution and Its Control
Process Utility and Industrial Safety	Corrosion Engineering	Battery Technology	Treatment of Industrial Effluent
Bridge Structures	Housing Planning & Management	Municipal Solid Waste Management	Repair and Rehabilitation of Structures
Town Planning	Green Building Techniques	Disaster Management	Remote Sensing Techniques and GIS
System Approach in Civil Engineering	Air & Noise Pollution	Construction Planning and Scheduling	Modern Construction Materials
Operating Systems	Computer Networks	Software Engineering	Data Mining
Computer Organisation	Real Time Systems	Cloud Computing	Software Project Management
Distributed Computing	Artificial Intelligence And Expert Systems	Soft Computing Techniques	Mobile Computing
Power Electronics	Renewable Energy Sources	Energy Management & Auditing	Electric & Hybrid Vehicles
Electrical Machine Design	Computer Aided Analysis and Design of Machines	Industrial Automation and Control	Power Plant Engineering
Industrial Electrical Systems	Green Buildings and Energy Conversion	Illumination Engineering	Introduction to Robotics
Microprocessors and Microcontrollers	Digital Signal Processing	Digital VLSI Design	Satellite Communication
Fiber Optics and Optoelectronic Devices	Nano Electronics	Embedded Systems	Digital Image and Video Processing
Communication System Engineering	Internet of Things	Mobile Communication	Wavelet Transforms
Sensors and Transducers	Process Simulation and Modelling	Biomedical Instrumentation	Micro-Electro-Mechanical Systems
Optoelectronic Devices and Instrumentation	Industrial Process Control and Dynamics	Industrial Automation & Control	Industrial Instrumentation
Process Instrumentation	Robotics and Robot Applications	Analytical Instrumentation	Optimal Control

SUBJECT CODE	COURSE TITLE	L	T	P	C	QP

BMEPE7140	REFRIGERATION AND AIR CONDITIONING LABORATORY	0	0	2	1	

Pre -Requisite: Engineering Thermodynamics and Mathematics

Course Educational Objectives

CEO1	Understand the basic principles of refrigeration and air conditioning
CEO2	Analyze air refrigeration systems, vapor compression refrigeration systems, vapour absorption refrigeration systems
CEO3	Study the psychometric properties of air and utilize the principles of psychometric in the design of air conditioning equipments
CEO4	Implement knowledge of psychometric for the design of refrigeration equipments and air conditioning equipments

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand the working principle of Refrigeration systems.
CO2	Determine the methods to increase the COP of Refrigeration cycles.
CO3	Estimate COP, Work input and Heat absorption from various refrigeration systems.
CO4	Calculate the performance of Cooling tower.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			1										
CO2			1	3										
CO3			1	3						2				
CO4			2	2										
Avg	0.5		1	2.25						0.5				

LIST OF EXPERIMENTS

List of Experiment:

1. Determination of C.O. P on vapour compression system
2. Determination of C.O. P on vapour absorption system
3. Performance test on Air conditioning test rig (Window type)
4. Performance test on Air conditioning test rig (Duct type)
5. Determination of C.O.P of Ice plant.
6. Determination of C.O. P of Heat Pump.
7. Performance analysis in an experimental cooling tower.
8. Study on Thermoelectric refrigeration/ Magnetic refrigeration.