GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)
Coimbatore - 641 013

Curriculum and Syllabi For
B.E. (PRODUCTION ENGINEERING)
(Full Time)

2016
Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
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VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

VISION AND MISSION OF THE DEPARTMENT

VISION

To be recognized globally for outstanding education, industrial orientation and research leading to grooming competitive engineers, who are innovative, entrepreneurial and successful in advanced fields of engineering and research.

MISSION

To develop technically competent, socially committed and disciplined production engineers with creative ability, innovative thinking and managerial skills to produce quality products for the benefit of mankind.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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.

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.

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.

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.

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.

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.

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

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

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.

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

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

DEPARTMENT OF PRODUCTION ENGINEERING

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Ability to design manufacturing processes, products, the equipment, tooling and necessary environment for the manufacture of products that meet specific material and other requirements.

PSO 2: Ability to use design, manufacturing and industrial engineering software packages to formulate and solve real time issues.

PSO 3: Ability to analyze, synthesis and control manufacturing operations using statistical methods and to create competitive advantage through the application of manufacturing planning, strategy, quality and control concepts.

BOARD OF STUDIES IN BASIC SCIENCES 2016-17
B.E.PRODUCTION ENGINEERING

CBCS 2016 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PHS1Z1	Communication Skills in English	HS	50	50	100	2	2	0	3
2	16PBS1Z2	Engineering Mathematics I	BS	50	50	100	3	2	0	4
3	16PBS103	Applied Physics	BS	50	50	100	3	0	0	3
4	16PBS104	Engineering Chemistry	BS	50	50	100	3	0	0	3
5	16PES105	Basics of Electrical and Electronics Engineering	ES	50	50	100	3	0	0	3
		PRACTICAL								
6	16PBS106	Physics Laboratory	BS	50	50	100	0	0	4	2
7	16PES107	Engineering Graphics	ES	50	50	100	2	0	4	4
		TOTAL		350	350	700				22

SECOND SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PHS2Z1	Technical English	HS	50	50	100	2	2	0	3
2	16PBS2Z2	Engineering Mathematics II	BS	50	50	100	3	2	0	4
3	16PBS2Z3	Materials Science	BS	50	50	100	3	0	0	3
4	16PHS2Z4	Environmental Science and Engineering	HS	50	50	100	3	0	0	3
5	16PES2Z5	Programming in C	ES	50	50	100	3	0	0	3
6	16PES206	Engineering Mechanics	ES	50	50	100	3	2	0	4
		PRACTICAL								
7	16PBS207	Chemistry Laboratory	BS	50	50	100	0	0	4	2
8	16PES208	Workshop Practice	ES	50	50	100	0	0	4	2
9	16PES2Z9	Programming in C Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		450	450	900				26

THIRD SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PBS3Z1	Engineering Mathematics III	BS	50	50	100	3	2	0	4
2	16PES302	Strength of Materials	ES	50	50	100	3	0	0	3
3	16PPC303	Fluid Mechanics and Machinery	PC	50	50	100	3	0	0	3
4	16PES304	Thermal Sciences	ES	50	50	100	3	2	0	4
5	16PPC305	Foundry and Welding Technology	PC	50	50	100	3	0	0	3
6	16PPC306	Engineering Metallurgy	PC	50	50	100	3	0	0	3
		PRACTICAL								
7	16PES307	Strength of Materials and Fluid Machinery Laboratory	ES	50	50	100	0	0	4	2
8	16PPC308	Metallurgy Laboratory and Thermal Science Laboratory	PC	50	50	100	0	0	4	2
		TOTAL		400	400	800				24

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PBS401	Probability and Statistics	BS	50	50	100	3	2	0	4
2	16PES402	Applied Electronics and Microprocessor	ES	50	50	100	3	0	0	3
3	16PES403	Electrical Machines and Drives	ES	50	50	100	3	0	0	3
4	16PPC404	Mechanics of Machines	PC	50	50	100	3	2	0	4
5	16PPC405	Metal Forming Processes	PC	50	50	100	3	0	0	3
6	16PPC406	Machine Tools and Processes	PC	50	50	100	3	0	0	3
		PRACTICAL								
7	16PPC407	Machine Drawing	PC	50	50	100	0	0	4	2
8	16PES408	Electrical Machines and Microprocessor Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		400	400	800				24

FIFTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PHS501	Total Quality Management	HS	50	50	100	3	0	0	3
2	16PPC502	Machine Elements Design	PC	50	50	100	3	2	0	4
3	16PPC503	Computer Numerical Control Machines	PC	50	50	100	3	0	0	3
4	16PPC504	Metrology and Computer Aided Inspection	PC	50	50	100	3	0	0	3
5	16PPC505	Fluid Power Drives and Controls	PC	50	50	100	3	0	0	3
6	OE - I	Open Elective I	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	16PPC507	Manufacturing Processes Laboratory I	PC	50	50	100	0	0	4	2
8	16PPC508	Metrology Laboratory	PC	50	50	100	0	0	4	2
		TOTAL		400	400	800				23

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PPC601	Operations Research Techniques	PC	50	50	100	3	2	0	4
2	16PPC602	Computer Aided Design	PC	50	50	100	3	0	0	3
3	16PPC603	Process Planning and Cost Estimation	PC	50	50	100	3	0	0	3
4	16PPC604	Jigs, Fixtures and Press Tools	PC	50	50	100	3	0	0	3
5	OE – II	Open Elective II	OE	50	50	100	3	0	0	3
6	PE - I	Professional Elective I	PE	50	50	100	3	0	0	3
		PRACTICAL								
7	16PPC607	Manufacturing Processes Laboratory II	PC	50	50	100	0	0	4	2
8	16PEE608	Modelling Laboratory	EEC	50	50	100	0	0	4	2
9	16PEE609	Mini Project	EEC	100	-	100	0	0	8	4
		TOTAL		500	400	900				27

SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16PPC701	Automation and CIM	PC	50	50	100	3	0	0	3
2	16PPC702	Production Planning and Control	PC	50	50	100	3	0	0	3
3	OE – III	Open Elective III	OE	50	50	100	3	0	0	3
4	PE – II	Professional Elective II	PE	50	50	100	3	0	0	3
5	PE – III	Professional Elective III	PE	50	50	100	3	0	0	3
6	PE – IV	Professional Elective IV	PE	50	50	100	3	0	0	3
		PRACTICAL								
7	16PEE707	Automation and Computer Aided Manufacturing Laboratory	EEC	50	50	100	0	0	4	2
8	16PEE708	Simulation Laboratory	EEC	50	50	100	0	0	4	2
		TOTAL		400	400	800				22

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	PE – V	Professional Elective V	PE	50	50	100	3	0	-	3
2	PE - VI	Professional Elective VI	PE	50	50	100	3	0	-	3
3	16PEE801	Project Work	EEC	50	50	100			16	8
		TOTAL		150	150	300				14

LIST OF PROFESSIONAL ELECTIVE SUBJECTS

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16PPEX01	Mechatronic Systems	PE	50	50	100	3	0	0	3
2	16PPEX02	Robotics and Machine Vision System	PE	50	50	100	3	0	0	3
3	16PPEX03	Finite Element Techniques	PE	50	50	100	3	0	0	3
4	16PPEX04	Production of Automotive Components	PE	50	50	100	3	0	0	3
5	16PPEX05	Unconventional Manufacturing Processes	PE	50	50	100	3	0	0	3
6	16PPEX06	Additive Manufacturing	PE	50	50	100	3	0	0	3
7	16PPEX07	Power Plant Engineering	PE	50	50	100	3	0	0	3
8	16PPEX08	Robust Design	PE	50	50	100	3	0	0	3
9	16PPEX09	Statistical Quality Control and Reliability Engineering	PE	50	50	100	3	0	0	3
10	16PPEX10	Advanced Welding Technology	PE	50	50	100	3	0	0	3
11	16PPEX11	Product Design and Process Engineering	PE	50	50	100	3	0	0	3
12	16PPEX12	Design for Manufacture and Assembly	PE	50	50	100	3	0	0	3
13	16PPEX13	Human Values and Professional Ethics-II	PE	50	50	100	3	0	0	3
14	16PPEX14	Plant Layout and Material Handling	PE	50	50	100	3	0	0	3
15	16PPEX15	Managerial Economics	PE	50	50	100	3	0	0	3
16	16PPEX16	Non Destructive Testing Techniques	PE	50	50	100	3	0	0	3
17	16PPEX17	Supply Chain Management	PE	50	50	100	3	0	0	3
18	16PPEX18	Production Management	PE	50	50	100	3	0	0	3
19	16PPEX19	Lean Manufacturing	PE	50	50	100	3	0	0	3
20	16PPEX20	Micro manufacturing Processes	PE	50	50	100	3	0	0	3
21	16PPEX21	Theory of Metal Cutting	PE	50	50	100	3	0	0	3
22	16PPEX22	Advanced Casting Technology	PE	50	50	100	3	0	0	3
23	16PPEX23	Total Productive Maintenance	PE	50	50	100	3	0	0	3
24	16PPEX24	Green Manufacturing	PE	50	50	100	3	0	0	3

LIST OF OPEN ELECTIVE SUBJECTS

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16AOEX01	Nanoscience and Technology	OE	50	50	100	3	0	0	3
2	16AOEX02	Material Characterizations	OE	50	50	100	3	0	0	3
3	16AOEX03	Electrochemical Technology	OE	50	50	100	3	0	0	3
4	16AOEX04	Polymer Technology	OE	50	50	100	3	0	0	3
5	16COEX05	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
6	16COEX06	Environmental Management	OE	50	50	100	3	0	0	3
7	16COEX07	Town Planning and Architecture	OE	50	50	100	3	0	0	3
8	16MOEX09	Composite materials	OE	50	50	100	3	0	0	3
9	16MOEX10	Automobile Engineering	OE	50	50	100	3	0	0	3
10	16EOEX11	Renewable Energy Sources and Technology	OE	50	50	100	3	0	0	3
11	16EOEX12	Smart Grid Technology	OE	50	50	100	3	0	0	3
12	16LOEX13	Principles of Communication	OE	50	50	100	3	0	0	3
13	16LOEX14	Microcontrollers and its applications	OE	50	50	100	3	0	0	3
14	16NOEX15	Industrial Automation Systems	OE	50	50	100	3	0	0	3
15	16NOEX16	Measurement and Instrumentation	OE	50	50	100	3	0	0	3
16	16SOEX17	Enterprise JAVA	OE	50	50	100	3	0	0	3
17	16SOEX18	Cyber Security	OE	50	50	100	3	0	0	3
18	16SOEX19	Network Essential	OE	50	50	100	3	0	0	3
19	16IOEX20	Programming in Python	OE	50	50	100	3	0	0	3
20	16IOEX21	BIG Data Science	OE	50	50	100	3	0	0	3
21	16IOEX22	Object Oriented Programming using C++	OE	50	50	100	3	0	0	3
22	16BOEX23	Computational Biology	OE	50	50	100	3	0	0	3
23	16BOEX24	Biology for Engineers	OE	50	50	100	3	0	0	3
24	16BOEX25	Fundamentals of Bioengineering	OE	50	50	100	3	0	0	3

LIST OF ONE CREDIT COURSES

(Max. 1 Course / Semester upto VII semester only)

Sl.No.	Course Code	Course Title
1	16POC1Z1	Human Values I
2	16POCX02	Human Values and Professional Ethics
3	16POCXZ3	Yoga for Youth Empowerment
4	16POCX04	Basics of Civil Engineering
5	16POCX05	Metallography
6	16POCX06	Design of Experiments using Taguchi Concept
7	16POCX07	Entrepreneurship Development
8	16POCX08	Patents Systems in Engineering
9	16POCX09	Industrial case studies
10	16POCX10	Project Management
11	16POCX11	Industrial safety
12	16POCX12	Six Sigma
13	16POCX13	Professional Skills
14	16POCX14	Solar Energy Systems
15	16POCX15	Wind Energy Systems
16	16POCX16	Refrigeration Systems
17	16POCX17	Air Conditioning Systems

CURRICULUM DESIGN 2016

FULL TIME B.E PRODUCTION ENGINEERING (U.G)

SUMMARY

Sl. No	Subject Area	Credits Per Semester								Total Credits	% of Total Credits	Total No. of subjects	AICTE recommended range of credits %	
		I	II	III	IV	V	VI	VII	VIII				Min	Max
1	HS	3	6	-	-	3	-	-	-	12	6.59	4	5	10
2	BS	12	9	4	4	-	-	-	-	29	15.93	9	15	20
3	ES	7	11	9	8	-	-	-	-	35	19.23	12	15	20
4	PC	-	-	11	12	17	15	6	-	61	33.52	21	30	40
5	PE	-	-	-	-	-	3	9	6	18	9.89	6	10	15
6	OE	-	-	-	-	3	3	3	-	9	4.95	3	5	10
7	EEC	-	-	-	-	-	6	4	8	18	9.89	5	10	15
Total		22	26	24	24	23	27	22	14	182	100	60		
8	Non-Credit/ Mandatory	1	-	-	-	-	-	-	-	1				

16PHS1Z1 **COMMUNICATION SKILLS IN ENGLISH** **Category : HS**

(Common to all branches)

L	T	P	C
2	2	0	3

Pre-Requisites: Nil

Course Objectives:

- To make the learners understand the usage of basic grammar in English.
- To enhance the learner's speaking skills through appropriate listening practice.
- To instill reading habits to practice communicative tasks and comprehension
- To improve the learner's writing skills through various means
- To enrich the vocabulary of learners for speaking and writing

UNIT I **6+6Periods**

Listening - Listening to practice basic pronunciation at phonemic and word level, Listening to informal conversations of exchanging greetings and introducing oneself/others; **Speaking**-Introducing oneself, one's family / friend, speaking about one's place; **Reading**-Reading to practice stress and pause; **Writing**-Autobiographical writing, Letter to seek permission, Letter to issue certificates; **Grammar**- Use of Auxiliary Verbs, Adjectives and Adverbs; **Vocabulary**-Word formation, Synonyms and Antonyms of High frequency words.

UNIT II **6+6Periods**

Listening-Listening to Telephone Conversations for taking and leaving messages, making enquiries; **Speaking—**Role-play activities based on real life situations, Narrating daily routines; **Reading**–skimming and scanning, Reading for comprehension with exercises; **Writing**-Advertisements and slogan writing, Imperative instructions, Definitions; **Grammar** – Tenses, Prepositions; **Vocabulary**-Commonly confused words

UNIT III **6+6Periods**

Listening -Listening to give instructions, Making requests and responding to requests, Thanking someone and responding to thanks; **Speaking** -Group Discussion on chosen topics, Describing a simple process; **Reading**-Reading and interpreting visual material, Critical reading; **Writing** –Letter to the Editor of a Newspaper, Recommendations; **Grammar**- Impersonal Passive, Subject-verb agreement; **Vocabulary**- Collocation, Word Association

UNIT IV **6+6Periods**

Listening-Listening to accept/refuse invitation, Listening to apologize, Listening to congratulate; **Speaking** – Debates on current social affairs; **Reading** –Reading to make inference, Paraphrasing; **Writing-** Personal letter (Inviting your friend to a function, congratulating someone on his / her success, thanking one's friends / relatives); **Grammar** – 'Wh'-questions, Modal verbs; **Vocabulary** - Single word substitutes -Use of abbreviations & acronyms

UNIT V **6+6Periods**

Listening -Video Listening to different accents, Viewing Speeches, Viewing English songs, Viewing short films; **Speaking** -Giving impromptu talks, Making presentations on given topics; **Reading** – Extensive reading; **Writing** –Writing General Article, Writing Short Stories; **Grammar** - Common Errors in English; **Vocabulary** –Word Pairs with Repetitive meaning.

Contact Periods:

Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course (Part 1)*	*Orient Blackswan, Hyderabad. 2014*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-I*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Rutherford, Andrea. J Basic	*Communication Skills for Technology*	*Pearson, New Delhi. 2001*
Redston, Chris, Cunningham, Gillie	*Face 2 Face: Elementary Student's Book*	*Cambridge University Press, New Delhi. 2009*

EXTENSIVE READING

(Not for Examination)

Kalam, Abdul.A.P.J . Wings of Fire. Universities Press, Hyderabad. 1999.

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES:

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

CO1: The learner will be able to understand basic grammar and the learner will have sufficient command over language by training his tongue and tuning his ear through apt listening tasks.

CO2: Reading tasks will enable the learner practice phonological and linguistic aspect of learning, help comprehend and create interest in extensive reading.

CO3: The learner shall be able to write appropriately for a given context and use the right word at the right place.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	-	-	M	-	M	-	-	-	-	-	-	-	L	L	L
CO 2	-	-	-	-	-	M	-	-	-	-	M	-	L	L	L
CO 3	-	-	-	-	-	-	-	-	-	H	-	-	L	L	L
16PHS1Z1	-	-	L	-	L	L	-	-	-	L	L	-	L	L	L

L- Low, M – Moderate (Medium), H - High

16PBS1Z2 **ENGINEERING MATHEMATICS I** **Category : BS**

(Common to all branches)

L T P C

3 2 0 4

Pre-Requisites: Nil

Course Objectives:

- To familiarize techniques of matrix algebra including properties of eigen values and eigen vectors.
- To gain the knowledge of hyperbolic functions and application problems in differential calculus.
- To familiarize with functions of several variables and Functions of two variables including extremum problems, Jacobian and Leibnitz rule of integration.
- To perform double and triple integration with relevant to surface area and volume of solid.

UNIT I **MATRICES** **9+6 Periods**

Eigen values and Eigen vectors of a real matrix-Characteristic equation-Properties of Eigen values and eigen vectors-Cayley Hamilton theorem - Diagonalization of matrices-Reduction of a quadratic form to canonical form by orthogonal transformation-Nature of quadratic forms.

UNIT II **HYPERBOLIC FUNCTIONS AND DIFFERENTIAL CALCULUS** **9+6 Periods**

Hyperbolic and Inverse Hyperbolic functions-Identities- Real and Imaginary parts-Solving Problems using Hyperbolic functions.

Curvature and radius of curvature-Cartesian and polar coordinates- center of curvature and Evolutes- Envelopes and Evolute as envelope of normal.

UNIT III **FUNCTIONS OF SEVERAL VARIABLES** **9+6 Periods**

Functions of two variables- Taylor's theorem (statement only) and expansions-Maxima and Minima-Constrained extremum by Lagrange's multiplier method-Jacobians-Differentiation under integral sign

UNIT IV **INTEGRAL CALCULUS** **9+6 Periods**

Definite and Indefinite integrals-Substitution rule-Techniques of Integration-Integration by parts-Trigonometric substitutions-Integration of rational function by partial fractions-Integration of irrational functions-Improper integrals.

UNIT V **MULTIPLE INTEGRALS** **9+6 Periods**

Beta and Gamma integrals and properties. Double Integrals-Change of order of integration-Double integrals in polar coordinates-Area enclosed by plane curves-Triple integrals-Volume as a triple integral-Transformation to Polar, Cylindrical and Spherical polar coordinates.

Contact Periods:

Lecture: 45 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Veerarajan T	*Engineering Mathematicsfor Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, ThilagavathyK and Gunavathy K	*Engineering Mathematics for I year B.E/B.Tech.*	*S.Chand& Co, Ramnagar, New Delhi, Reprint2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus, Vol.I , II and III,*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley & sons (Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition, 2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014*

COURSE OUTCOMES:

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

CO1: Acquire knowledge of eigen values and eigen vectors including properties through matrix theory.

CO2: Understand the hyperbolic functions and applications of differential calculus.

CO3:Acquire fluency in partial differentiation and solving problems related to maxima and minima for more independent variables.

CO4: Understand the standard types of integration and solution to various integrals.

CO5: Understand the multiple integrals and their applications to engineering problems.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	H	H	H	M	-	-	-	-	-	H	M	M	-	L	-
CO 2	H	M	M	-	-	-	-	-	-	M	-	-	L	M	L
CO 3	H	H	H	-	-	-	-	-	-	L	-	-	M	L	L
CO 4	H	H	M	M	-	-	-	-	-	M	L	M	-	-	-
CO 5	H	M	M	-	-	-	-	-	-	L	L	M	M	L	L
16PBS1Z2	H	H	M	M	-	-	-	-	-	M	L	M	M	L	L

L- Low, M – Moderate (Medium), H - High

16PBS103 **APPLIED PHYSICS** **Category: BS**

(Common to Civil, Mechanical, Production and Industrial Biotechnology branches)

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- Concepts, types of lasers and its applications, fibre optic principles and its applications.
- Basics of properties of matter & thermal physics
- Origin of quantum physics, Schrödinger's equation and applications.
- Principles of acoustics, ultrasonics and their industrial applications.
- Fundamentals of vacuum science, production and measurement.

UNIT I **LASERS & FIBRE OPTICS** **9 Periods**

Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein's coefficients - population inversion – methods of achieving population inversion –Optical Resonator -Types of Lasers – Principle, construction and working of Nd-YAG, CO_2,Semiconductor laser - applications of laser-Hologram.

Introduction – Basic Principles involved in fiber optics- Total internal reflection – Structure of optical fiber –Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links-Fiber optic sensors-displacement

UNIT II **PROPERTIES OF MATTER & THERMAL PHYSICS** **9 Periods**

Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity - Bending moment - Depression of a cantilever - Young's modulus by uniform bending - I shaped girders.

Thermal expansion - thermal stress - thermal conductivity - heat conduction in solids - flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment.

UNIT III **QUANTUM PHYSICS AND APPLICATIONS** **9 Periods**

Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation-de-Broglie wavelength in terms of voltage, energy, and temperature –Heisenberg's Uncertainty principle – verification – physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations –- Particle in a one dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).

UNIT IV **ACOUSTICS & ULTRASONICS** **9 Periods**

Classification of sound - loudness and intensity - Weber-Fechner law - standard intensity and intensity level - decibel - reverberation - reverberation time - sound absorbing materials - Determination of absorption coefficient - factors affecting acoustics of buildings.

Introduction - properties of ultrasonic waves - production of ultrasonic waves; Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonics-cavitation - applications- ultrasonic drilling-ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system

UNIT V **VACUUM SCIENCE** **9 Periods**

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

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Arumugam M	*Engineering Physics*	*Anuradha Publishers, 2010. (Unit I & Unit III)*
P.K.Palanisamy	*Engineering physics-I*	*SciTech Publications (India) Pvt. Ltd,2015. (Unit II & Unit IV)*
Ganesan S and Iyandurai N	*Applied Physics*	*KKS Publishers, Chennai, 2007.(Unit V)*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Avadhanulu M N and Kshirsagar P G	*A Textbook of Engineering Physics*	*S.Chand and Company Ltd, New Delhi, 2010.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private limited, New Delhi,2015.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Analyze the construction and working of Nd-YAG, CO_2, Semiconductor lasers. Explain fiber optics and classify fibers based on index profiles and modes. **[Familiarity]**
CO2: Acquire knowledge in properties of matter and thermal Physics **[Application]**
CO3: Analyze the dual nature of matter using Heisenberg's Uncertainty principle, Schrodinger's
time independent and dependent wave equations. **[Assessment]**
CO4: Apply piezoelectric detector method for industrial applications. **[Usage and Assessment]**
CO5: Production & Measurement of vacuum. **[Familiarity]**

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	H	H	H	H	H	H	H	-	-	-	-	-	L	L	L
CO 2	H	H	H	H	H	H	H	-	-	-	-	-	L	L	L
CO 3	M	M	-	-	M	M	M	-	-	-	-	-	L	L	L
CO 4	H	H	H	H	H	H	H	-	-	-	-	-	L	L	L
CO 5	H	H	H	H	H	H	H	-	-	-	-	-	L	L	M
16PBS103	H	H	H	H	H	H	H	-	-	-	-	-	L	L	L

L- Low, M – Moderate (Medium), H - High

16PBS104 **ENGINEERING CHEMISTRY** **Category : BS**

(Common to Civil, Mechanical and Production)

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- The course is aimed at imparting knowledge of Engineering Chemistry topics which would be useful for students to understand chemistry relevant to conventional engineering fields.

UNIT I **WATER TECHNOLOGY** **9 Periods**

Water- sources - types of impurities, hardness - temporary and permanent – units - ppm and mg/L - estimation of hardness – EDTA method- problems- Boiler troubles- internal treatment – external treatment- lime soda process and ion exchange process- Drinking water – characteristics- colour, odour, turbidity, chloride - treatment - preliminary, primary and disinfection methods- chlorination-breakpoint chlorination, desalination – reverse osmosis.

UNIT II **POLYMER TECHNOLOGY** **9 Periods**

Polymers- definitions of monomer, polymer, functionality, degree of polymerisation –Free radical mechanism -Individual polymers- PVC, PMMA, Teflon, polyamide, poly carbonate, epoxy, polyurethane-preparation, properties and their end users- compounding of plastics-components and functions- fabrication techniques- compression, injection, extrusion and blow moulding- Conducting polymers- structures of polypyrrole, polyaniline and poly acetylene- conduction mechanism of polyacetylene only - Biodegradable polymers – polylactide, starch and cellulose.

UNIT III **FUELS AND COMBUSTION** **9 Periods**

Fuels- classifications - calorific value - Gross and Net-Determination by Dulong's formula-problems - combustion –theoretical air-principle and calculations - solid fuels – Coal-proximate and ultimate analysis- significance- Coke- characteristics- manufacture by Otto Hoffman method - Liquid fuels – petroleum- fractionation - petrol and diesel - knocking of IC engines and diesel engines - octane and cetane numbe- anti-knocking agents – Biogas – biodiesel.

UNIT IV **ENGINEERING MATERIALS** **9 Periods**

Refractories – classification - properties and manufacture of silica and magnesia bricks; Abrasives-Classification-properties - manufacture of SiC -; Lubricants –solid lubricants (Graphite & Molybdenum sulphide) hydrodynamic mechanism of lubrication – Cement – manufacture - setting and hardening of cement - special cements - Alumina cement, waterproof cement, high early strength cement.

UNIT V **CORROSION** **9 Periods**

Corrosion- Spontaneity - Chemical corrosion- mechanism, nature of oxides – PillingBedworth rule-electrochemical corrosion – mechanism- types – galvanic and differential aeration – Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques(sacrificial anode and impressed current cathode), Inhibitors - Protective coatings-Inorganic coating-electroplating – surface preparation and plating method applied to Cr and Ni and galvanising – Organic coating- paints - constituents and functions.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Vairam S, Subha Ramesh	*Engineering Chemistry*	*Wiley India, 2015.*
Jain. P.C. and Monica Jain	*Engineering Chemistry*	*Dhanpat Rai publications Pvt. Ltd, New Delhi, 16th Edition, 2015.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Dara. S.S, Umare	*Text book of Engineering Chemistry*	*S. Chand Publications, 2004.*
Agarwal C.V.	*Chemistry of Engineering Materials*	*9th Edition, B.S. Publications, 2006.*
Kuriakose, J.C., and Rajaram J	*Chemistry in Engineering and Technology", Vol.1 & II,*	*Tata Mc Graw Hill Publishing company Pvt.Ltd, New Delhi, 2001.*
O.P. Aggarwal, Avinash Aggarwal	*Engineering Chemistry*	*Khanna Publishers, 2010.*
Sivasankar B	*Engineering Chemistry*	*Tata McGraw Hill Publications, 2008.*

COURSE OUTCOMES:

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

CO1: Understand the nature of impurities and the effects of various sources of water, and apply them in treatment them usable for industrial and domestic purposes.

CO2: Know about the different types of polymeric materials, properties and fabrication which match the specific applications.

CO3: Learn the different types of fuels with their compositions, combustion characteristics in engines and apply them in design of combustion chambers.

CO4: Be familiar with the various engineering materials, refractories, abrasives, lubricants and cements with their properties and manufacturing methods which are used in engineering applications.

CO5: Gain the knowledge about corrosion of the machinery they use in their fields and, also to understand the mechanisms and to adopt the preventive measures by various techniques.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	H	M	M	L	L	M	L	M	L	M	L	L	L	L	M
CO 2	H	L	H	L	L	M	M	H	L	L	L	L	L	L	M
CO 3	M	L	H	L	L	M	L	H	L	M	M	L	L	L	M
CO 4	H	M	H	L	L	M	H	H	H	L	M	M	L	L	M
CO 5	H	M	M	M	L	L	L	L	H	L	M	L	L	L	M
16PBS104	H	M	H	L	L	H	M	M	H	L	M	L	L	L	M

L- Low, M – Moderate (Medium), H - High

16PES105 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING Category : ES

(Common to Mechanical, Production and Industrial Biotechnology branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To study the basic concepts of electric circuits, electronic devices and communication engineering.
- To know the fundamental of energy conversion, construction, principle of operation, characterization of DC machines and AC machines.

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 9 Periods

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MACHINES 9 Periods

Construction, Principle of Operation, Basic Equations and Types, Characteristics and Applications of DC Generators, DC Motors, Single Phase Transformer, Single Phase induction motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 9 Periods

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers - Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Working principle and Characteristics of FET, JFET, MOSFET – Characteristics and Simple Application of SCR, DAC, TRIAC & UJT – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 9 Periods

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders - Flip-Flops – Registers and Counters – A/D and D/A Conversion (Simple concepts).

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9 Periods

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Microwave, Satellite, RADAR and Optical Fibre (Block Diagram Approach only).

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Muthusubramanian R, Salivahanan S and Muraleedharan K A	*Basic Electrical and Electronics Engineering*	*Tata McGraw Hill, Second Edition, (2009).*
Mittle.V.N and Arvind Mittal	*Basic Electrical Engineering*	*Tata McGraw Hill, Second Edition, New Delhi, 2005.*
Sedha R.S	*A Text book of Applied Electronics*	*S. Chand & Co., 2008.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Nagsarkar T K and Sukhija M S	*Basics of Electrical Engineering*	*Oxford Press (2005).*
Mehtra V.K and Rohit Mehta	*Priniciples of Electrical Engineering and Electronics*	*S. Chand & Co. 2nd Edition 2015.*
Mahmood Nahvi and Joseph A. Edminister	*Electric Circuits, Schaum' Outline Series*	*McGraw Hill, Sixth edition (2014)*
Premkumar N and Gnanavadivel J	*Basic Electrical and Electronics Engineering*	*Anuradha Publishers, 4th Edition (2008).*

COURSE OUTCOMES:

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

CO1: Analyze simple DC and AC Circuits.
CO2: Understand the significance of Electrical machines.
CO3: Apply knowledge on semiconductor devices and Integrated circuits.
CO4: Understand the concepts of communication engineering.
CO5: Design simple circuits using electronic components for specific applications.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO 3
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO 1	H	H	-	-	-	-	M	-	-	-	L	M	M	M	L
CO 2	H	M	M	-	-	-	M	-	-	-	L	-	M	M	L
CO 3	H	L	L	-	M	-	L	-	-	-	-	-	L	L	L
CO 4	H		L	-	M	M	L	-	-	-	L	L	L	L	L
CO 5	H	M	H	M	M	L	-	-	-	-	L	M	M	M	L
16PES105	H	M	M	M	M	M	M	-	-	-	L	M	M	M	L

L- Low, M – Moderate (Medium), H - High

16PBS106 **PHYSICS LABORATORY** **Category : BS**

(Common to Civil, Mechanical, Production and Industrial Biotechnology branches)

L T P C
0 0 4 2

Pre-Requisites: Nil

Course Objectives:

- To have a practical knowledge about the concepts behind physics and the need to apply in the emerging technology.

LIST OF EXPERIMENTS

1. Spectrometer - Diffraction Grating Normal Incidence Method
2. Air Wedge –Determination of thickness of a paper
3. Young's Modulus – Cantilever Bending - Koenig's Method
4. a. Laser - Particle size Determination

   b. Optical fiber - Determination of NA & Acceptance angle
5. Ammeter and Voltmeter Calibration – Low Range
6. Resistance Of The Given Coil Of Wire – Carey Foster's Bridge
7. Determination of Band gap Energy of Semiconductor
8. Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.
9. Transistor Characteristics
10. Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Determinate all physical properties of any matter, basic idea of calibrating electrical Measuring instruments and thereby effectively using it for particular applications.

CO2: Experiment intrinsic characteristic features of electronic devices for electrical and Electronic applications.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	M	M	M	M	M	M	M					M	L	L
CO2	M	M	M	M	M	M	M					M	M	M
16PBS106	M	M	M	M	M	M	M					M	L	L

L- Low, M – Moderate (Medium), H – High

16PES107 **ENGINEERING GRAPHICS** **Category : ES**

(Common to Civil, Mechanical, Production and Industrial Biotechnology branches)

L	T	P	C
2	0	4	4

Pre-Requisites: Nil

Course Objectives:

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Interpretation of solids.
- Pictorial view of solids

UNIT I **GEOMETRICAL CONSTRUCTIONS** **15Periods**

Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon- Construction of curves like ellipse, parabola, cycloid and involute using one method.

UNIT II **ORTHOGRAPHIC PROJECTIONS** **25 Periods**

Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces-Projection of planes-Conversion of pictorial views to orthographic views-Projection of solids – Auxiliary projections.

UNIT III **SECTION OF SOLIDS AND DEVELOPMENT** **20Periods**

Section of solids- Development of surfaces

UNIT IV **INTERPENETRATION OF SOLIDS and PICTORIAL VIEWS** **20 Periods**

Cylinder and cylinder, cone and cylinder only Isometric projections – Conversion of orthographic views to pictorial views (simple objects).

UNIT V **INTRODUCTION TO AUTOCAD** **10Periods**

Object Construction: Page layout – Layers and Line types – Creating, Editing and selecting the Geometric Objects. Viewing, Annotating, Hatching and Dimensioning the drawing –Creating Blocks and Attributes

Contact Periods:

Lecture: 30 Periods **Tutorial: 0Periods** **Practical: 60 Periods** **Total: 90 Periods**

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
K.Vengopal	*Engineering Graphics*	*New Age International (P) Limited, 2015.*
Dhananjay.A.Jolhe	*Engineering Drawing*	*Tata McGraw Hill Publishing Co., 2007.*
K.V.Nataraajan	*A text book of Engineering Graphics*	*Dhanalakashmi Publishers, Chennai, 2006.*
M.B.Shah and B.C. Rana	*Engineering Drawing*	*Pearson Education, 2005.*
Luzadder and Duff	*Fundamentals of Engineering Drawing*	*Prentice Hall of India Pvt Ltd, XI Edition, 2001.*
K.L.Narayana and P.Kannaiah	*Text book on Engineering Drawing*	*2nd Ed., Scitech Publications (India) Pvt. Ltd, Chennai, 2009.*

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO1: Represent planes and solids as per international standards.

CO2: Generate and interpret multiple views through development, interpretation and sectional views.

CO3: Generate and interrupt orthographic views.

CO4: Generate and interrupt pictorial views and interpenetration.

CO5: Generate and interrupt perspective views.

CO6: Apply the concept of AUTO CAD in engineering graphics.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	H	H	-	-	M	-	L	H	M	-	M	L	L	L
CO 2	-	-	H	-	-	M	-	L	H	M	-	M	L	L	L
CO 3	-	-	H	-	-	M	-	L	H	M	-	M	L	L	L
CO 4	-	-	H	-	-	M	-	L	H	M	-	M	L	L	L
CO 5	-	-	H	-	-	M	-	L	H	M	-	M	L	L	L
CO6	-	H	H	H	-	M	-	L	H	M	-	M	H	H	L
16PES107	-	L	H	L	-	M	-	L	H	M	-	M	M	M	L

L- Low, M – Moderate (Medium), H - High

16PHS2Z1 **TECHNICAL ENGLISH** **Category : HS**

(Common to all branches)

L T P C

2 2 0 3

Pre-Requisites: Nil

Course Objectives:

- To make learners acquire guided listening and speaking skills in both formal and informal contexts.
- To help them develop reading skills by familiarizing them with different types of reading tasks and strategies.
- To make them understand advance level of grammar and equip them with writing skills needed for academic as well as workplace contexts.
- To explore the learner to Technical English and Technical Vocabulary.

UNIT I **6+6 Periods**

Listening - Listening to ask for/ give opinions, Listening to persuade/dissuade people, Listening to make complaints, Listening to transfer information; **Speaking** –Role play activities on a formal/corporate context, Delivering Welcome Address- **Reading** – Reading to infer lexical and contextual meaning; **Writing** - Effective use of SMS on Whatsapp/ Hike/ Messenger, Writing E-mails on a business context, Technical style; **Grammar** – Use of relative / reflexive pronouns, Discourse Markers; **Vocabulary**- Homonyms and Homophones

UNIT II **6+6 Periods**

Listening - Listening to express regrets/sympathy/condolences, Listening and Note-taking; **Speaking** – Addressing at an official meeting to deal with problems/ sensitive issues, Discussion on a movie with a poignant social message/ or on a recently read book; **Reading** - Reading a short story or an article from newspaper; **Writing** - Writing a review of a book/movie/music concert/sports event, Graph Description; **Grammar** – Noun/Adjective/Adverbial phrases, Cause and effect expressions; **Vocabulary** - Using phrasal verbs in sentences, Jargon

UNIT III **6+6 Periods**

Listening - Listening to a talk about using quantities, Listening to describe manner and frequency, Listening to expressions of assumptions/inference, Listening to make comparisons; **Speaking** – Making conversation to practice stress, pause, pronunciation and intonation, Introducing the chief-guest; **Reading** - Speed reading – reading passages with time limit - **Writing** – Notice, Agenda and Minutes of meetings; - Elements of Writing Technical articles –**Grammar** - Numerical expressions, Conditional clauses; **Vocabulary** - Same word used as different parts of speech, Register

UNIT IV **6+6 Periods**

Listening - Listening to talks about future events/plans, Listening to a talk about making arrangements, Listening to language of reporting, Viewing a model discussion; **Speaking** – Discussion on a formal/corporate context, Proposing vote of thanks; **Reading** - Reading the job advertisements and the profile of the company concerned; **Writing** - Process Description, Applying for a job with résumé; **Grammar** - Direct and indirect speech; **Vocabulary** - Idioms

UNIT V **6+6 Periods**

Listening – Listening to expressions of possibility, Listening to expressions of obligations, Listening to expressions of ability, Viewing model interviews; **Speaking** - Mock interview; **Reading** - Note making, Intensive reading; **Writing** – Checklist, - Feasibility / Project report; **Grammar** – Time Statements and Contracted Time Statements; **Vocabulary** – Nominal Compounds

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers.*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course (Part 2).*	*Orient Blackswan, Hyderabad. 2014*

Contact Periods:
Lecture: 30 Periods Tutorial: 30Periods Practical: 0 Periods Total: 60 Periods

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-II*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Herbert, A.J	*Structure of Technical English*	*The English Language Society, London. 1971*
Michigan, E.A	*Word Power and Speed Reading: English Improvement Series*	*Infinity Books, New Delhi, 2007*
Rajendrapal & Korlahalli. J.S	*Essentials of Business Communication*	*Sultan Chand & Sons*

WEBSITES
1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES:

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

CO1: The learners will be able to speak convincingly at work place and social contexts through guided listening tasks and different genres and strategies of reading.

CO2: The learner will understand advance level of grammar and write professionally to a larger extent for workplace and general contexts.

CO3: The learners will familiarize themselves with Technical Vocabulary and Technical English.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	L	-	L	M	-	-	-	-	M	L	L	L
CO2	-	-	-	-	-	-	-	-	-	H	-	L	L	L
CO3	-	-	-	-	-	-	-	-	-	-	-	L	L	L
16PHS2Z1	-	-	L	-	L	L	-	-	-	L	L	L	L	L

L- Low, M – Moderate (Medium), H - High

16PBS2Z2 **ENGINEERING MATHEMATICS II** **Category : BS**

(Common to all branches)

L T P C

3 2 0 4

Pre-Requisites: Basics of - trigonometry- differential and integral formulae.

Course Objectives:

- To acquire knowledge of techniques of ordinary differential equations leading to engineering problems.
- To acquire knowledge of vector Calculus with engineering applications.
- To gain standard techniques of complex variable applicable to fluid dynamics, heat conduction, and elasticity.
- To develop skill of solving transforms leading to engineering applications.

UNIT I **ORDINARY DIFFERENTIAL EQUATIONS** **9+6 Periods**

Second and Higher order Differential Equations, Method of variation of parameters- Method of undetermined coefficients-Homogeneous equations of Euler's and Legendre's type-System of Simultaneous first order Linear equations with constant coefficients - Method of reduction of order.

UNIT II **VECTOR CALCULUS** **9+6 Periods**

Gradient and directional derivative, Divergence and Curl – Irrotational and Solenoidal fields- Vector identities - Line, Surface and Volume Integrals – Green's Theorem in a Plane , Gauss Divergence and Stoke's Theorems (Statements only) –Verifications and Applications.

UNIT III **COMPLEX DIFFERENTIATION** **9+6 Periods**

Functions of a Complex variable-Analytic functions- Cauchy Riemann equations and sufficient conditions (excluding proof)–Harmonic conjugates–Construction of analytic functions-Conformal mappings: $w=z+a$, az, $1/z$, z^2, e^z , sinz, cosz and Bilinear Transformation.

UNIT IV **COMPLEX INTEGRATION** **9+6 Periods**

Cauchy's integral theorem, Cauchy's integral formula -Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration – Circular and semi circular contours with no pole on real axis.

UNIT V **LAPLACE TRANSFORMATIONS** **9+6 Periods**

Laplace transforms- Properties and standard transforms-Transforms of unit step, unit Impulse and error functions –Transforms of periodic functions- Inverse Laplace transforms- Initial and Final value theorems- Convolution theorem (Statement only) and applications - Applications to Solution of Linear differential equations of second order with constant coefficients.

Contact Periods:

Lecture: 45 Periods **Tutorial: 30Periods** **Practical: 0 Periods** **Total: 75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Veerarajan T	*Engineering Mathematics" for Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, Thilagavathy K and Gunavathy K	*Engineering Mathematics" for I year B.E/B.Tech*	*S.Chand& Co, Ramnagar, New Delhi,Reprint2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus-Vol.III*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley &sons(Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition,2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014.*

COURSE OUTCOMES:

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

CO1: Understand the kinds of differential equations and their solutions in the field of engineering.

CO2: Evaluate gradient, divergence and curl and also line, surface and volume integrals in cartesian form and simple coordinate systems and calculate integrals applying Greens, stokes and Gauss theorems.

CO3: Understand the concepts of analytic functions and conformal mappings.

CO4: Evaluate contour integrals using calculus of residues.

CO5: Apply Laplace transform methods to solve differential equations.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	H	-	-	-	-	-	M	H	H	M	-	-
CO 2	H	H	M	M	-	-	-	-	-	M	-	M	H	M	L
CO 3	H	H	M	H	-	M	-	-	-	M	M	M	L	-	-
CO 4	H	H	M	M	-	M	-	-	-	M	M	M	L	-	-
CO 5	H	H	H	H	-	H	-	-	-	M	M	H	M	M	-
16PBS2Z2	H	H	M	H	-	M	-	-	-	M	M	M	M	M	L

L- Low, M – Moderate (Medium), H - High

16PBS2Z3 **MATERIALS SCIENCE** **Category : BS**

(Common to all branches)

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- The properties of conducting materials.
- The application of magnetic and super conducting materials.
- Application and properties of dielectric and ferro electric materials.
- Applications and properties of Modern engineering materials.
- Nano materials and its properties.

UNIT I CONDUCTING MATERIALS 9 Periods

Introduction to Conductors – classical free electron theory of metals – Draw backs of classical theory – quantum theory - Electrical and Thermal conductivity of Metals – Derivation for Wiedeman – Franz law – Lorentz number — Fermi distribution function - effect of temperature – density of energy states – calculation of Fermi energy- carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS AND DEVICES 9 Periods

Introduction – Properties – elemental and compound semiconductors - Intrinsic and extrinsic semiconductors – properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature and carrier concentration - Electrical Conductivity – band gap determination - extrinsic semiconductors - Carrier concentration in P- type and N-type semiconductors – variation of Fermi level with temperature and impurity concentration – Hall effect- Determination of Hall Co-efficient in N type and P type Semiconductor - Applications.

UNIT III MAGNETIC AND SUPER CONDUCTING MATERIALS 9 Periods

Introduction - Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Ferrites - structure and applications. - Magneto optical recording and readout – Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- High Tc superconductors, Applications of superconductors- SQUID, Cryotron, Magnetic levitation.

UNIT IV DIELECTRICS AND FERROELECTRICS 9 Periods

Introduction to dielectric materials – Electric polarization and Dipole moment - Electrical susceptibility – dielectric constant – Various polarization mechanisms in dielectrics - electronic, ionic, orientational and space charge polarization– frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials - Ferro electricity –Ferro electric materials -$BaTiO_3$ – Applications- Ferro electric energy converter.

UNIT V MODERN ENGINEERING MATERIALS 9 Periods

Metallic glasses- preparation of metallic glasses - properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gel – ball Milling – properties of nanoparticles and applications of nanoparticles – Carbon Nanotubes (CNT) – structure – properties – applications of CNTs.

Contact Periods:

Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
P.K.Palanisamy	*Engineering Physics–II*	*Scitech Publications (India) Pvt. Ltd 2015 (Unit I, Unit III & Unit IV)*
Dr.Jayakumar .S	*Materials science*	*R.K.Publishers,2008.(Unit II & IV)*
Dr.V.Rajendran	*Material Science*	*Tata McGraw Hill Publications, NewDelhi, 2011.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Charles P.Poole, Jr; Frank J.Owens	*Introduction to Nanotechnology*	*Wiley India, 2012.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private Ltd, New Delhi, 2015.*

COURSE OUTCOMES:

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

CO1: Analyze the properties of conducting materials. **[Familiarity]**

CO2: List and analyze the properties of Semiconducting materials and Devices. **[Familiarity]**

CO3: Identify, analyze the properties and applications of magnetic & super conducting materials. **[Familiarity]**

CO4: List and analyze the properties of dielectric Ferro electric materials. **[Familiarity & Application]**

CO5: List the properties and applications of modern engineering materials. **[Familiarity & Application]**

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	M	-	-	-	M	M	-	-	-	-	-	L	L	L
CO 2	M	M	M	M	M	M	M	-	-	-	-	-	M	M	M
CO 3	H	H	H	H	H	H	H	-	-	-	-	-	M	M	M
CO 4	H	H	H	H	H	H	H	-	-	-	-	-	M	M	M
CO 5	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
16PBS2Z3	M	M	-	-	-	M	M	-	-	-	-	-	L	L	L

L- Low, M – Moderate (Medium), H - High

16PHS2Z4 **ENVIRONMENTAL SCIENCE AND ENGINEERING** *(Common to all branches)* **Category : HS**

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- The course is aimed at creating awareness among students and also to inseminate the critical ideas of preserving environment.

UNIT I ENVIRONMENTAL RESOURCES 9 Periods

Natural resources -Forest – benefits, over exploitation, deforestation & consequences – Water - unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication& biomagnifications -Energy resources - renewable & non-renewable resources - wind, solar and tidal - harnessing methods.

UNIT II ECO SYSTEM AND BIODIVERSITY 9 Periods

Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem - forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – insitu – ex situ conservation.

UNIT III ENVIRONMENTAL POLLUTION 9 Periods

Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_x, H_2S, CO, CO_2 and particulates, control methods - cyclone separator and electrostatic precipitator -Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants Soil pollution - sources, effects and control - Noise pollution - decibel scale, sources, effects and control.

UNIT IV ENVIRONMENTAL THREATS 9 Periods

Acid rain, greenhouse effect, global warming and ozone depletion, disaster management, flood, drought, earthquake and tsunami, Threats to biodiversity-destruction of habitat, habit fragmentation-hunting, over exploitation and man-wildlife conflicts, The IUCN red list categories, status of threatened species.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9 Periods

Sustainable development- sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation act, population growth- exponential and logistic growth, variation in population among nations, population policy, women and child welfare programs, role of information technology in human and health, HIV/AIDS - effects and preventive measures.

Contact Periods:

Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Sharma J.P	*"Environmental Studies", 3rd Edition*	*University Science Press, New Delhi 2009.*
Anubha Kaushik and C.P. Kaushik	*"Environmental Science and Engineering", 3rd Edition*	*New age International Publishers, New Delhi, 2008.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
R.K. Trivedi	*Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards", Vol.I&II,*	*Environ Media, 2006.*
G. Tyler Miller Jr	*"Environmental Science", 10th Edition*	*Thomson Brooks/Cole Publishing, 2004.*
Gilbert M. Masters	*Introduction to Environmental Engineering and Science, 2nd Edition*	*Pearson Education, 2004.*

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO1: To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.

CO2: To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.

CO3: To be aware of the source of various types of pollution, their ill effects and preventive methods.

CO4: To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.

CO5: To create an idea about sustainable development and social issues.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L	H	L	M	M	M	M	M	M	L	L	L	L	L
CO 2	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO 3	L	L	H	L	L	L	M	M	L	M	L	L	L	L	L
CO 4	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
CO 5	M	L	M	L	L	L	H	H	L	M	L	L	L	L	L
16PHS2Z4	M	L	H	L	L	L	H	H	L	L	L	L	L	L	L

L- Low, M – Moderate (Medium), H - High

16PES2Z5 **PROGRAMMING IN C** **Category : ES**

(Common to all branches)

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course, the students will be familiar with,

- The Computer and Programming fundamentals
- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

UNIT I COMPUTER AND PROGRAMMING FUNDAMENTALS 9 Periods

Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.

UNIT II DATA TYPES AND FLOW OF CONTROL 9 Periods

An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control

UNIT III FUNCTIONS, ARRAYS, POINTERS AND STRINGS 9 Periods

Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic memory allocation – Strings – String handing functions – Multidimensional Arrays.

UNIT IV ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES 9 Periods

Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.

UNIT V STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS 9 Periods

Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.

Contact Periods:

Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Pradip Dey, Manas Ghosh	*Computer Fundamentals and Programming in C, Second Edition*	*Oxford University Press, 2013.*
Al Kelley, Ira Pohl	*A Book on C- Programming in C, Fourth Edition*	*Addison Wesley, 2001.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Stephen G. Kochan	*Programming in C-A complete introduction to the C programming language, Third Edition*	*Sams Publication, 2004.*
Yashavant P. Kanetkar	*Let Us C, 13th edition*	*BPB Publications, 2013.*
Brian W. Kernighan and Dennis Ritchie	*The C Programming Language", Second Edition*	*Prentice Hall Software Series, 1988.*
Stephen Prata	*C Primer Plus, Fifth Edition*	*Sams Publishing, 2005.*

COURSE OUTCOMES:

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

CO1: Articulate the programming environment **[Familiarity]**

CO2: Write algorithm for solving the given problem statement [usage]

CO3: Use right data types and flow control statement **[Assessment]**

CO4: Write programs using functions, arrays, pointers and strings **[Usage]**

CO5: Use right storage classes, preprocessor directives, bitwise operators in programs **[Assessment]**

CO6: Use structures, unions and files **[Usage]**

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	M	H	H	-	M	M	M	M	L	M	L	L	L
CO 2	H	H	M	H	H	-	-	M	M	M	L	M	M	M	M
CO 3	H	H	M	H	H	-	-	M	M	M	L	M	L	M	L
CO 4	H	H	M	H	H	-	-	M	M	M	L	M	L	M	L
CO 5	H	H	M	H	H	-	-	M	M	M	L	M	M	L	L
CO6	H	H	M	H	H			M	M	M	L	M	-	L	L
16PES2Z5	H	H	M	H	H	-	M	M	M	M	L	M	L	M	L

L- Low, M – Moderate (Medium), H - High

16PES206 **ENGINEERING MECHANICS** **Category : ES**

(Common to all except ECE, CSE and IT branches)

L T P C
3 2 0 4

Pre-Requisites: Nil

Course Objectives:

- To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

UNIT I **INTRODUCTION TO MECHANICS AND FORCE CONCEPTS** **9+6 Periods**

Principles and Concepts–Laws of Mechanics – system of forces – resultant of a force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force into force and couple – forces in space –addition of concurrent forces in space – equilibrium of a particle in space.

UNIT II **FRICTION** **9+6 Periods**

Frictional resistance – classification of friction- laws of friction –coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.

UNIT III **GEOMETRICAL PROPERTIES OF SECTION** **9+6 Periods**

Centroids – Determination by integration– moment of inertia – theorems of moment of inertia – Product of Inertia –Principal moment of inertia of plane areas- radius of gyration.

UNIT IV **BASICS OF DYNAMICS - KINEMATICS** **9+6 Periods**

Kinematics and kinetics – displacements, velocity and acceleration- Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height.

UNIT V **BASICS OF DYNAMICS - KINETICS** **9+6 Periods**

Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy. Principle of impulse and momentum – Equations of momentum –Laws of conservation of momentum. Impact– Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.

Contact Periods:

Lecture: 45 Periods **Tutorial: 30Periods** **Practical: 0 Periods** **Total: 75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
S.S. Bhavikatti and K.G. Rajasekarappa	*Engineering Mechanics*	*New Age International Pvt Ltd. 1999.*
S.C. Natesan	*Engineering Mechanics*	*Umesh Publications, 5-B north market, Naisarak, Delhi, 2002.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
F.B. Beer and E.R. Johnson	*Vector Mechanics for Engineers*	*Tata Mc.Graw Hill Pvt Ltd, 10th Edition, 2013.*
S. Timoshenko and Young	*Engineering Mechanics*	*Mc.Graw Hill, 4th Edition, 1995.*
Irving Shames and Krishna Mohana Rao	*Engineering Mechanics*	*Prentice Hall of India Ltd, Delhi, 2006.*
Domkundwar V.M and Anand V. Domkundwar	*Engineering Mechanics (Statics and Dynamics)*	*Dhanpat Rai and Co. Ltd, 1st Edition, 2006.*
Suhas Nitsure	*Engineering Mechanics*	*Technical Publications, Pune, 1st edition, 2006.*
R.C. Hibbeller	*Engineering Mechanics*	*Prentice Hall of India Ltd, 13th Edition, 2013.*
Vela Murali	*Engineering Mechanics*	*Oxford university Press,1stEdition, 2010.*

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO1: Analyze the problems related to force systems and friction

CO2: Apply concepts of centre of gravity and moment of inertia

CO3: Solve problems on dynamics, momentum and impulse

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	H	M	L	L	-	-	-	L	-	L	-	M	L	H
CO2	L	H	L	-	L	-	-	-	L	-	L	-	L	L	L
CO3	M	H	M	L	L	-	-	-	L	-	L	-	M	L	L
16PES206	M	H	M	L	L	-	-	-	L	-	L	-	M	L	L

L- Low, M – Moderate (Medium), H - High

16PBS207 **CHEMISTRY LABORATORY** **Category: BS**

(Common to Civil, Mechanical, Production and IBT branches)

L	T	P	C
0	0	4	2

Pre-Requisites: Nil

Course Objective:

- The course is aimed at imparting knowledge of experimental techniques which would be useful for students to apply the practical principles relevant conventional engineering field.

LIST OF EXPERIMENTS

1. Estimation of hardness by EDTA method.
2. Estimation of chloride by Argentometric method.
3. Determination of dissolved oxygen by Winkler's method.
4. Conductometric titration of mixture of strong acid and weak acid using strong base.
5. Potentiometric titration of ferrous iron by dichromate.
6. Estimation of copper in brass by EDTA method.
7. Estimation of Iron by Spectrophotometry
   Estimation of HC1 by pH titration.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0Periods** **Practical: 60 Periods** **Total: 60 Periods**

REFERENCE BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
A.O. Thomas,	*Practical Chemistry*	*Scientific Book Centre, Cannanore, 2003.*
Jeffery G H, Basset J. Menthom J, Denney R.C.	*Vogel's Text book of quantitative analysis, 5th Edition*	*EBS, 1988.*

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Understand the nature of hardness, chloride level, pollution level using dissolved oxygen content, iron present in water and analyse them in water.

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	L	L	M	L	L	L	L	M	L	M	L	L	L
CO2	H	M	L	L	M	L	L	L	L	M	L	M	L	L	L
16PBS207	H	M	L	L	M	L	L	L	L	M	L	M	L	L	L

L- Low, M – Moderate (Medium), H - High

16PES208 **WORKSHOP PRACTICE** **Category : ES**

(Common to Civil, Mechanical, Production and Industrial Biotechnology branches)

L T P C
0 0 4 2

Pre-Requisites: Nil

Course Objectives:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise &Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal.
2. Safety aspects in Welding, Carpentry and Foundry.
3. Half lap Joint and Dovetail Joint in Carpentry.
4. Welding of Lap joint, Butt joint and T-joint.
5. Preparation of Sand mould for cube, conical bush, pipes and V pulley.
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal.
7. Electrical wiring – simple house wiring.
8. Plumbing

Contact Periods:

Lecture: 0 Periods **Tutorial: 0Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Use tools and equipments used in Carpentry, Welding, Foundry and Sheet metal.

CO2: Make half lap joint and dovetail joint in carpentry.

CO3: Make welded lap joint, butt joint and T-joint.

CO4: Prepare sand mould for cube, conical bush, pipes and V pulley.

CO5: Fabricate parts like tray, frustum of cone and square box in sheet metal

CO6: Carry out minor works/repair related to electrical wiring and plumbing.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	H	H	-	-	M	-	L	H	M	-	M	L	M	L
CO 2	-	-	H	-	-	M	-	L	H	M	-	M	M	M	L
CO 3	-	-	H	-	-	M	-	L	H	M	-	M	M	M	L
CO 4	-	-	H	-	-	M	-	L	H	M	-	M	L	L	L
CO 5	-	-	H	-	-	M	-	L	H	M	-	M	H	M	L
CO6	-	H	H	H	-	M	-	L	H	M	-	M	L	L	L
16PES208	-	L	H	L	-	M	-	L	H	M	-	M	M	M	L

L- Low, M – Moderate (Medium), H - High

16PES2Z9 **PROGRAMMING IN C LABORATORY** **Category : ES**

(Common to all branches)

L T P C
0 0 4 2

Pre-Requisites: Nil

Course Objectives:

- Data types in C and Flow control statements.
- Functions, Arrays, Pointers and Strings.
- Dynamic memory allocation and command line arguments.
- Bitwise Operators, Preprocessor Directives, Structures and Unions.
- Structures, List Processing, Input And Output

PRACTICALS
EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1. Operators , Expressions and IO formatting
2. Decision Making and Looping
3. Arrays and Strings
4. Functions and Recursion
5. Pointers
6. Dynamic Memory Allocation
7. Structures
8. Unions
9. Files
10. Command line arguments
11. Mini Project

Contact Periods:
Lecture: 0 Periods **Tutorial: 0Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Use appropriate data types and flow control statements **[Usage]**

CO2: Write programs using functions, arrays, pointers and strings **[Usage]**

CO3: Write programs using dynamic memory allocation **[Usage]**

CO4: Implement programs using right storage classes, preprocessor directives, bitwise operators **[Usage]**

CO5: Work with command line arguments, structures, unions and files **[Usage]**

CO6: Develop applications using C [**Usage]**

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	M	H	H	-	-	M	M	M	L	M	L	L	L
CO 2	H	H	M	H	H	-	-	M	M	M	L	M	M	L	L
CO 3	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO 4	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO 5	H	H	M	H	H	-	-	M	M	M	H	M	L	L	L
CO6	H	H	M	H	H	-	-	M	M	M	M	H	M	M	L
16PES2Z9	H	H	M	H	H	-	-	M	M	M	M	M	M	L	L

L- Low, M – Moderate (Medium), H - High

16PBS3Z1 **ENGINEERING MATHEMATICS III** Category: BS

(Common to all Branches)

L	T	P	C
3	2	0	4

Pre-Requisites: Nil

Course Objectives:

- To gain the knowledge of formation of Fourier series.
- To familiarize with Infinite and finite Fourier transforms functions.
- To be familiar with solution of first and second order differential equations.
- To acquire knowledge of techniques to solve one and two dimensional partial differential equations concerning to engineering applications.

UNIT- I	**FOURIER SERIES**	**(9+6)**
Dirichlet's conditions - Full range Expansions - Odd and even functions - Half range sine and cosine series – Parseval's identity on a Fourier series - Harmonic analysis		
UNIT- II	**FOURIER TRANSFORMS**	**(9+6)**
Fourier integral theorem (statement only) - Infinite Fourier transform pair - Fourier sine and cosine transform pair - Properties -Transforms of simple functions - Parseval's identity on a Fourier transform - Finite Fourier transforms.		
UNIT- III	**PARTIAL DIFFERENTIAL EQUATIONS**	**(9+6)**
Formation of partial differential equations - First order PDE - Standard types and Lagrange's type - Linear partial differential second and higher order with constant coefficients - Homogeneous and Non-homogeneous types		
UNIT- IV	**BOUNDARY VALUE PROBLEMS**	**(9+6)**
Method of separation of variables and Fourier series solution: One dimensional wave equation, one and two dimensional heat flow.		
UNIT- V	**Z TRANSFORMS**	**(9+6)**
Z transforms-properties-Inverse Z transforms-Initial and final value theorems- Convolution theorem- Formation of difference equations- Solution to difference equations of second order difference equations with constant coefficients with Z transform.		

Contact Periods:
Lecture: 45 Periods Tutorial: 30Periods Practical: 0 Periods Total: 75 Periods

Text Books

Author Name	Title of Book	Publisher, Year of Publication
Veerarajan T	*Transforms and partial differential equations*	*Tata McGraw Hill Publishing Co., New Delhi, 2015*
Kandasamy, Thilagavathy and Gunavathy	*Engineering Mathematics for semester III B.E/B.Tech*	*S.Chand& Co, Ramnagar, New Delhi, 2013*

Reference Books

1. *Grewal B .S, "Higher Engineering Mathematics" Khanna Publishers, New Delhi, 43rd Edition, 2014.*
2. *Ramana B. V, "Higher Engineering Mathematics" Tata McGraw Hill Co. Ltd., New Delhi, 11th Edition, Reprint, 2010.*
3. *Bali N., Goyal M, "Transforms and Partial differential equations" University Science Press, New Delhi, 2010*
4. *Ray Wylie C and Louis C Barrett, "Advanced Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 6th Edition, Reprint ,2014.*
5. *Donald.A.McQuarrie,, "Mathematical Methods for Scientists and Engineers", Viva Books Pvt. Ltd., New Delhi, 1st Edition, Reprint ,2015.*

Course Outcomes

On completion of this course, students will be able to

CO 1: Understand the concepts of Fourier series and its construction when discrete and continuous form is known.

CO 2: Acquire fluency in Fourier transforms in order to solve improper integrals.

CO 3: Understand the standard and special types of partial differential equations.

CO 4: Gain fluency in solving boundary value problems.

CO 5: Understand the Z transform methods to find solutions of difference equations.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	-	-	-	-	-	-	H	-	-	-	-	-
CO 2	M	H	M	-	-	-	-	-	-	M	-	-	-	-	-
CO 3	H	M	-	-	-	-	-	-	-	L	-	-	-	-	-
CO 4	H	H	M	-	-	M	-	-	-	M	M	-	-	-	-
CO 5	M	M	M	-	-	-	-	-	-	-	-	-	-	-	-
16PBS3Z1	H	H	M	M	-	M	-	-	-	L	M	-	-	-	-

L- Low, M – Moderate (Medium), H - High

16PES302 **STRENGTH OF MATERIALS** Category: ES

(Common to Production and Mechanical Engineering)

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PES206 - Engineering mechanics

Course Objectives:

- To understand the basic concepts of stress, strain, shear force, bending moment and deflection for different types of loading conditions.
- To understand the deflection of beams, theory of columns and application of torsion.

UNIT- I	STRESS AND STRAIN	(09)
Stress and strain at a point-Tension, compression, shear stresses - Hooke's law - Compound bars – lateral strain - Poisson's ratio -Volumetric strain - Bulk modulus - Relationship among elastic constants – stress strain diagrams for mild steel, cast iron-Ultimate stress - Yield stress-Factor of safety - Thermal stresses - Thin cylinders - Strain energy due to axial force - Resilience- Stress due to gradual load, suddenly applied load and Impact load.		
UNIT- II	**SHEAR FORCE AND BENDING MOMENT**	**(09)**
Beams – Types of Beams - Types of loads, supports - Shear force – Bending moment – shear forces and bending moment diagrams for cantilever, simply supported and over hanging beams with concentrated, uniformly distributed and uniformly varying load-Relationship between rate of loading, shear force, bending moment- Point of contra flexure.		
UNIT- III	**THEORY OF BENDING AND COMPLEX STRESSES**	**(09)**
Theory of bending-Bending equation-Section Modulus-Stress distribution at a cross section due to bending moment and shear force for cantilever, simply supported beams with point, UDL loads(Rectangular, circular, I & T sections only) -combined direct and bending stresses, Kernel of section (Rectangular, Circular Sections only). 2D State of stress - 2D Normal and shear stresses on any plane-Principal stresses and Principal planes-Principal Strains and direction-Mohr's circle of stress.		
UNIT- IV	**DEFLECTION OF BEAMS AND THEORY OF LONG COLUMNS**	**(09)**
Determinations of deflection curve – Relation between slope, deflection and radius of curvature – Slope and deflection of beam at any section by Macaulay's method - Concept of Conjugate beam method (Theory only)- Euler's theory of long Columns- Expression of crippling load for various end conditions-Effective length-Slenderness ratio-limitations of Euler equation - Rankine formula for columns.		
UNIT- V	**THEORY OF TORSION**	**(09)**
Torsion of shafts - Torsion equation - Polar modulus- Stresses in Solid and Hollow circular shafts - Torsional rigidity - Power transmitted by the shaft – Importance of angle of Twist - Strain energy due to Torsion - Modulus of rupture – Torsional resilience – Combined bending and Torsion- Stresses in helical springs - Deflection of helical spring-Leaf springs.		

Contact Periods:

Lecture:45 Periods **Tutorial: 0Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Sadhu Singh	*Strength of Materials*	*Khana Publishers, New Delhi, 2000*
Rajput.R. K	*Strength of Materials*	*S. Chand & Company Ltd., New Delhi 2002*
James M.Gere	*Mechanics of Materials*	*Thomson India, Brooks/cole, 2006*

Reference Books:

1. *Dr.B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain., "Mechanics of Materials", Lakshmi Publications Pvt Ltd, New Delhi, 2002.*
2. *Kazimi, "Solid Mechanics", Tata McGraw Hill, New Delhi, 1998.*
3. *Robert L.Mott, "Applied Strength of Materials", PHI Learning Pvt. Ltd, New Delhi, 2009.*
4. *Jindal U C, "Textbook on Strength of Materials", Asian Books Pvt. Ltd., 2007.*
5. *Ramamrutham S and Narayan R, "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 2000.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Find the stress, strain and modulus for different materials.

CO2: Understand the knowledge of shear force and bending moment diagrams of beams.

CO3: Calculate the complex stresses in beams with different loading conditions.

CO4: Find the deflection behaviour of beams and slender columns.

CO5: Apply the concepts of torsion in shafts and springs.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	L	H	-	M	-	L	-	-	-	-	-	-	L	L	L
CO 2	L	M	H	L	M	-	-	-	-	L	-	-	L	-	L
CO 3	-	H	L	H	M	-	-	-	-	L	-	-	L	-	L
CO 4	M	H	L	M	L	-	-	-	-	-	-	-	L	-	L
CO 5	L	H	-	M	-	L	-	-	-	-	-	-	L	-	L
16PES302	L	H	L	M	M	L	-	-	-	L	-	-	L	-	L

L- Low, M – Moderate (Medium), H – High

16PPC303 **FLUID MECHANICS AND MACHINERY** Category: PC

(Common to Production and Mechanical Engineering) **L T P C**

3 0 0 3

Pre-Requisites:

1. 16PES206 - Engineering mechanics

Course Objectives:

- To understand the basic principles in fluid mechanics and behavior study of fluid particles under rest and moving conditions.
- To understand the moment principle in fluid mechanics and its application in flow through pumps and turbines.

UNIT- I	**FLUID PROPERTIES**	**(09)**
Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, Capillarity, Compressibility and Bulk modulus – Pascal's Law – pressure measurements – manometers - Fluid statics - Total pressure and centre of pressure on submerged surfaces.		
UNIT- II	**FLUID KINEMATICS AND DYNAMICS**	**(09)**
Types of fluid flow and flow lines – control volume – continuity equation in one-dimension and three dimension – velocity potential and stream function - Energy equation – Euler and Bernoulli's equations – Applications of energy equations- Flow meters - Laminar and Turbulent flow through pipes - Governing Equations.		
UNIT- III	**MOMENTUM PRINCIPLE**	**(09)**
Impulse momentum principle - Application of momentum principle - Impact of Jet - Force exerted by a jet on normal, inclined and curved surfaces for stationary and moving cases -Angular momentum principle - construction of velocity vector diagram.		
UNIT- IV	**HYDRAULIC TURBINES**	**(09)**
Classification – construction, working principles and design of Pelton wheel, Francis and Kaplan Turbines - head, losses, work done and efficiency - specific speed - operating characteristics - Governing of Turbines.		
UNIT- V	**PUMPS**	**(09)**
Classification of pumps - Centrifugal pump - working principle - discharge, work done and efficiencies – Gear oil and Multistage pumps - Reciprocating pumps - work done and efficiencies - negative slip - flow separation conditions - air vessels - indicator diagram and its variation - savings in work done.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

Text Books

Author Name	Title of Book	Publisher, Year of Publication
Rajput.R.K.	*A text Book of Fluid Mechanics and Machinery*	*S. Chand and Company, NewDelhi , 2002*
Ramamrutham.S and Narayanan.R.	*Fluid Hydraulics and Fluid Machines*	*Dhanpat Rai Publishing House (P) Ltd , New Delhi, 2000.*
Modi.P.N. and Seth.S.M.	*Hydraulics and Fluid Mechanics including Hydraulic Machines*	*Standard book house,Delhi, 2002*

Reference Books

1. *Streeter, Victor L .and Wylie, E. Benjamin, "Fluid Mechanics", McGraw Hill Ltd., 1998.*
2. *Natarajan.M.K., "Fluid Machines", Anuradha Agencies, VidayalKaruppur, Kumbakonaam, 1995.*
3. *Kumar.K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 2000.*

Course Outcomes

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

CO 1: Identify the importance of fluids properties and fluid principles at rest.

CO 2: Know the physical behavior of fluids system and equations under moving conditions.

CO 3: To apply the concept of momentum principle at stationary and moving vanes.

CO4: To conduct the performance test on different types of turbines.

CO5: To conduct the performance study and selection of pumps for different applications

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	H	L	L	M	-	-	-	-	-	-	-	-	-	M
CO 2	H	M	L	M	L	-	-	-	-	-	-	-	L	-	M
CO 3	L	L	M	H	L	-	-	-	-	-	-	-	L	-	M
CO 4	L	M	M	H	L	-	-	-	-	L	-	-	M	-	H
CO 5	L	M	M	H	L	-	-	-	-	L	-	-	H	-	M
16PPC303	M	M	M	H	L	-	-	-	-	L	-	-	L	-	M

L- Low, M – Moderate (Medium), H – High

16PES304 **THERMAL SCIENCES** Category: ES

L T P C
3 2 0 4

Pre-Requisites: Nil

Course Objectives:

- To understand the basic laws of Thermodynamics and Heat and mass transfer.
- To understand the principle of operation of thermal equipment like IC engine, boiler, and refrigerator etc.

UNIT- I	**THERMODYNAMICS**	**(9+6)**
Thermodynamic systems - zeroth law, first and second laws of thermodynamics, applications, steady flow energy equation, ideal gas processes - calculation for work done, heat transfer and entropy changes.		
UNIT- II	**POWER PLANTS**	**(9+6)**
Rankine cycle(without reheat and regeneration), Steam power plant, Brayton cycle, gas turbine power plant, cogeneration and combined cycle power plants. Global energy requirements – role of energy managers in industries.		
UNIT- III	**IC ENGINES**	**(9+6)**
Carnot cycle, Otto, diesel cycles,Principles of operations of IC Engines, valve and port timing diagrams, indicator diagrams, carburetors – simple and Solex; diesel fuel pump and injector, need for cooling and lubrication of IC engines, coil and magneto ignition systems, mechanical, brake thermal and indicated thermal efficiencies.		
UNIT- IV	**REFRIGERATION AND AIR-CONDITIONING**	**(9+6)**
Refrigeration - vapour compression cycles - vapour absorption cycle, comparison between vapour compression and absorption systems. Properties of steam: P - V, T - S and H - S diagrams-Psychrometry, Psychrometric chart – processes.		
UNIT- V	**HEAT AND MASS TRANSFER**	**(9+6)**
Heat conduction through plane and cylinder, critical thickness of insulation,natural and forced convection. Radiation, Surface emission properties, Stefan-Boltzmann law, Kirchhoff's law.Mass Transfer - Mode of mass transfer, Concentrations, Velocities and Fluxes.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 30Periods** **Practical: 0 Periods** **Total: 75 Periods**

Text Books

Author Name	Title of Book	Publisher, Year of Publication
Yunus A Cengel	*Introduction to Thermodynamics and Heat Transfer*	*McGraw Hill Inc., New York, 2007.*
Nag.P.K,	*Engineering Thermodynamics*	*Tata McGraw-Hill, New Delhi, 2008.*
R.K.Rajput	*Thermal Engineering*	*Laxmi Publications (P) Ltd, 6th edition New Delhi, 2006.*

Reference Books

1. R.K.Rajput,"Heat and Mass Transfer"5th Edition,S.Chand& Company ltd,2012.

2.Kothandaraman.C.P., Domkundwar.S. andA.V.Domkundwar., "A course in Thermal Engineering", Dhanpat Rai and Sons., 5th edition, 2000.

3.Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 2007.

4.Arora.C.P., "Refrigeration and Air conditioning", TMH, 1994.

5.Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.

6.Nag P.K, "Power plant Engineering", Tata McGraw-Hill, 1998.

7.Ganesan V, "Internal Combustion Engines", Tata McGraw Hill Publishing Company, New Delhi, 2007.

Course Outcomes

On completion of this course, students will be able to

CO1: describe the thermodynamic systems and various laws of thermodynamics.

CO2: explain various thermodynamic cycles.

CO3: describe about IC engines.

CO4: describe the refrigeration and air conditioning systems.

CO5: explain about heat and mass transfer in a thermodynamic system.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M	M	-	L	-	-	L	H	-	L	L	-	L
CO2	M	M	L	H	-	M	-	-	L	H	-	M	L	-	L
CO3	M	L	L	M	-	M	-	-	L	H	-	M	L	-	L
CO4	M	L	H	H	-	M	M	-	L	M	-	M	L	-	L
CO5	M	L	L	L	-	M	M	-	L	M	-	M	L	L	L
16PES304	M	M	M	M	-	M	L	-	L	M	-	M	L	L	L

L – Low, M- Moderate (Medium), H – High

16PPC305 **FOUNDRY AND WELDING TECHNOLOGY** Category: PC

L T P C

3 0 0 3

Pre-Requisites: Nil

COURSE OBJECTIVES:

- To familiarize the basic principles of casting and welding processes.
- To make the students to learn the various casting and welding methods including advanced techniques.

UNIT- I	**INTRODUCTION TO CASTING**	**(09)**
Patterns : Making - materials, types, allowances pattern making - Moulding: materials, equipment, sand preparation and testing - Cores and core making - Design considerations in casting, gating system – Melting and heat treatment furnaces.		
UNIT- II	**CASTING PROCESSES**	**(09)**
Casting processes: steps, advantages, limitations and applications of sand castings, permanent mould casting - pressure die casting, centrifugal casting - precision casting: investment casting, shell moulding -continuous casting, squeeze casting - Fettling and finishing -casting defects and inspection.		
UNIT- III	**ARC AND GAS WELDING PROCESSES**	**(09)**
Types of welding - Positions of welding-types of weld joints - Arc welding: power sources-electrodes – flux – types: SMAW, GTAW, GMAW, SAW, ESW. Gas welding - equipment - welding symbols – types - pre and post weld heat treatments. Welding defects: causes and remedies - Welding inspection.		
UNIT- IV	**SPECIAL WELDING PROCESSES**	**(09)**
Resistance welding: spot, seam, projection, percussion, flash types - atomic hydrogen arc welding - thermit welding - Soldering, brazing and braze welding - Electron beam welding, laser beam welding, plasma arc welding and ultrasonic welding - explosive welding - Friction stir welding - Under water welding.		
UNIT- V	**AUTOMATION OF CASTINGANDWELDING**	**(09)**
Layout of mechanized foundry - sand reclamation - Material handling in foundry - pollution control in Foundry - Recent trends in casting - Computer Aided design of Castings - Process. Automation in welding - Welding robots - Seam tracking vision and arc sensing - Overview of automation in various industries.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books

Author Name	Title of Book	Publisher, Year of Publication
Rao P.N	*Manufacturing Technology: Foundry Forming and Welding*	*4th edition, McGraw Hill Education (India), New Delhi, 2013.*
Little R.L	*Welding and Welding Technology*	*Tata McGraw Hill, 2008*
Heine R., Loper C. and Rosenthal P	*Principles of Metal Casting*	*Tata McGraw Hill Publishing Co. Ltd., New Delhi, 33rd Reprint, 2008.*

Reference Books

1. *Parmer R.S., "Welding Processes & Technology", Khanna Publishers, 2013.*
2. *Campbell J., "Casting Practice", Elsevier Science Publishing Co., 2004.*
3. *Parmer R.S., "Manufacturing processes and Automation", Khanna Publishers, 2012.*
4. *SeropeKalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology – Anna University", 4th edition, Pearson Education, India, 2014.*

Course Outcomes

On completion of this course, students will be able to

CO 1:describe the fundamentals of metal casting processes.

CO 2: classify the different metal casting processes with their inherent merits and limitations.

CO 3:describe the fundamentals of welding processes.

CO 4: classify the different welding processes with their inherent merits and limitations.

CO 5: discuss about the automation in foundries and welding shops.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M												M		
CO2	M												M		
CO3	M												M		
CO4	M												M		
CO5	M				M								M		
16PPC305	M				M								M		

L- Low, M – Moderate (Medium), H - High

16PPC306 **ENGINEERING METALLURGY** Category: PC

(Common to Production and Mechanical) **L T P C**

3 0 0 3

Pre-Requisites:

1. 16PBS103- Applied Physics
2. 16PBS2Z3- Materials Science

Course Objectives :

- To study the phase diagrams, various heat treatment methods, principles of foundry, welding and powder metallurgy and to acquire knowledge on testing materials, properties and application of various methods.

UNIT - I	**CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**	**(9)**
Constitution of alloys – Solid solutions, substitutional and interstitial –phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram.		
UNIT - II	**HEAT TREATMENT AND SURFACE TREATMENT**	**(9)**
Definition – Full annealing, process annealing, stress relief, recrystallisation - spheroidizing – normalising, hardening and tempering of steels – austempering, martempering - Isothermal transformation diagrams – cooling curves superimposed on I.T diagram- CCR - hardenability, Jominy end quench test - Case hardening, carburising, nitriding, cyaniding, carbonitriding–Flame and Induction hardening.		
UNIT - III	**FERROUS AND NON FERROUS METALS**	**(9)**
Plain carbon steels – alloy steels - Effect of alloying elements (Mn, Si, Cr, Mo, V , Ni, Ti& W) on properties of steel - stainless and tool steels – Gray, White, Malleable, Spheroidal graphite - alloy cast irons – heat resistant steels and die steels. Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin - Important alloys - their composition, properties and applications - Material Specification and standards.		
UNIT - IV	**FOUNDRY AND POWDER METALLURGY**	**(9)**
Solidification of pure metals and alloys – melting – super heating – fluxing – micro and macro segregation – hot tears – heat transfer and structural change - Production of powders, mixing, blending, compacting, sintering and hot pressing – secondary operations- application of powder metallurgy – advantages and limitations.		
UNIT - V	**WELDING METALLURGY AND TESTING OF MATERIALS**	**(9)**
Weldability – heat distribution during welding and thermal effects on parent metals – HAZ – factors affecting HAZ - hardening, cracking, distortion and residual stresses – stress relief treatment of welds – Mechanical tests - tension, compression, impact, hardness, Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic Particle inspection and Liquid penetrant inspection test - Eddy current testing.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

Text Books

Author Name	Title of Book	Publisher, Year of Publication
Higgins R.A	*Engineering Metallurgy*	*5th edition, EIbs,1983.*
Dieter, G.E	*Mechanical metallurgy, SI metric edition*	*McGraw-Hill, ISBN 0-07-100406-8, 1988.*
Sydney H.Avner	*Introduction to Physical Metallurgy*	*Tata McGraw Hill Book Company, 1994.*

Reference Books

1. *William D Callsber "Material Science and Engineering", Wiley India pvt Ltd 2007.*
2. *Lakhtin Yu., "Engineering Physical Metallurgy and Heat Treatment", Mir Publisher,1985.*
3. *Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.*
4. *GUY.A.G., "Elements of Physical Metallurgy", Oxford & IBH Pub.Co,1990.*
5. *O.P.Khanna,"Material Science And Metallurgy", Dhanpat Rai Publication ,2011*

Course Outcomes:

On completion of this course, students will be able to

CO 1: predict the alloy components and its composition variation with respect to temperature changes.

CO 2: select suitable materials and heat treatment methods for various industrial applications.

CO 3: understand the ferrous and nonferrous materials and their application

CO 4: apply the knowledge of foundry and powder metallurgy to solve various industrial production processes.

CO 5: gain knowledge about materials testing methods and welding techniques to meet industrial requirements.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	P0	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L				M			L				L	M		
CO2	M		H		H								H	M	
CO3	H	M			M								M	H	L
CO4	L	M			M								L	M	
CO5	L					M	H				L				L
16PPC306	L				M			L				L	M		

Low, M – Moderate (Medium), H – High

16PES307	STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY *(Common to Production and Mechanical Engineering)*	Category: ES **L T P C** **0 0 4 2**

Pre-Requisites:

1. 16PES302–Strength of Materials
2. 16PPC303 Fluid Mechanics and Machinery

Course Objectives:

- To understand the basics of different testing methods for different materials.
- To study the behaviour of fluid system at rest and motion and performance analysis of pumps and turbines.

STRENGTH OF MATERIALS LABORATORY	
LIST OF EXPERIMENTS	**(30)**
1. Tension Test on steel rods using Universal Testing Machine. 2. Bending Test on rolled steel Joist Beam. 3. Double shear test on mild steel rod. 4. Torsion Test on Mild steel rod 5. Tension and Compression Test on Springs 6. Deflection test on simply supported aluminium beam 7. Deflection Test on Cantilever Beam 8. Hardness tests on metals like Mild Steel, Brass, Copper and Aluminium 9. Bend Test on Steel rod 10. Compression Test 11. Impact test-izod and charpy	
FLUID MECHANICS AND MACHINERY LABORATORY	
LIST OF EXERCISES	**(30)**
1. Determination of Darcy's friction factor 2. Calibration of Flow Meters 3. Flow through Mouth Piece 4. Performance study on Centrifugal pump 5. Performance study on reciprocating pump 6. Performance study on Submersible Pump 7. Performance study on Gear oil Pump 8. Load test on Pelton Wheel Turbine 9. Load test on Kaplan Turbine	

Contact Periods:

Lecture: 60 Periods Tutorial: 0Periods Practical: 0 Periods Total: 60Periods

Course Outcomes

On completion of this course, students will be able to

CO1: Apply knowledge of compression, tension, shear and torsion testing procedures on materials.

CO2: Know the deflection and bending behaviour of different types of beams.

CO3: Find the hardness of different metals.

CO4: Find the flow properties of fluids.

CO5: Conduct performance tests on pumps and turbines and draw the performance curves.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	M	L	L					M				L		L
CO 2	M	H	L	M	L				L				L		L
CO 3	L	H		M		L			L				L		L
CO 4	M	H	L	L	M				L				L		
CO 5	L	M	M	H	L				L	L			L		
16PES307	M	H	L	M	L	L			L	L			L		L

L- Low, M – Moderate (Medium), H - High

16PPC308 METALLURGY LABORATORYANDTHERMALSCIENCE LABORATORY Category: PC

L	T	P	C
0	0	4	2

16PPC308 (A) METALLURGYLABORATORY

L	T	P	C
0	0	2	1

Pre-Requisites: Nil

Course Objectives:

- To impart the skill of micro structural examination, defect examination and heat treatment of ferrous and nonferrous materials.

LIST OF EXERCISES
1. Study of Metallurgical microscope
2. Preparation of Specimen for micro-examination
3. Study of Iron carbon Equilibrium diagram
4. Study of Microstructure of materials
- Steel (low carbon steel, high carbon steel, HSS, Spheroidised steel)
- Cast iron (grey, white, SG)
- Non Ferrous (brass, Gun metal, aluminium, silicon alloy)
5. Study of Heat Treatment processes (Annealing, Normalizing, Hardening and Tempering)
6. Study of non-destructive tests
- Liquid penetrant test
- Ultrasonic inspection
- Magnetic particle inspection
- Radiography
7. Determination of Hardenability by Jominy end quench test.

Contact Periods:

Lecture: 0Periods Tutorial: 0Periods Practical: 30 Periods Total: 30Periods

Course Outcomes

On completion of this course, students will be able to

CO1: prepare specimen for microscopic examination and identify the microstructures of ferrous and nonferrous engineering components.

CO2: select suitablenon destructive tests for finding flaws in a material.

CO3: realize the effect of heat treatment on the properties of materials.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	M	H	L	L	-	L	-	-	L	-	L	-	M	-	M
CO 2	H	M	L	L	-	L	-	-	L	-	L	-	M	-	M
CO 3	M	L	-	L	-	L	L	-	L	-	L	-	M	-	M
16PPC308A	M	M	L	L	-	L	L	-	L	-	L	-	M	-	M

L- Low, M – Moderate (Medium), H - High

16PPC308 (B) THERMAL SCIENCELABORATORY

L	T	P	C
0	0	2	1

Pre-Requisites: Nil

Course Objectives:

- To impart the skill of conducting tests on I.C engines, compressors and blowers for finding the performance and other related characteristic parameters.

LIST OF EXERCISES

- Valve timing and port timing diagrams of single cylinder diesel engines.
- Performance test on 4 stroke Diesel Engine using various loading devices.
- Retardation test to find Frictional Power of a Diesel Engine.
- Economical speed test on Diesel Engine.
- Performance test on Constant speed blower.
- Performance test on Variable speed blower.
- Performance test on Reciprocating Air compressor.

Contact Periods:
Lecture: 0 Periods Tutorial: 0Periods Practical: 30 Periods Total: 30Periods

Course Outcomes

On completion of this course, students will be able to

CO 1: Conduct performance tests on diesel engines with different types of loading devices to access the performance.

CO 2: Find the opening / closing timings of valves or ports in engines.

CO3: Conduct performance tests on blowers and reciprocating compressor to access the performance.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	M	L	L	-	H	H	-	L	-	M	-	-	-	M
CO 2	M	M	L	L	-	M	M	-	L	-	L	-	-	-	M
CO 3	H	M	L	L	-	H	H	-	L	-	M	-	-	-	M
16PPC308B	M	M	L	L	-	M	M	-	L	-	L	-	-	-	M

L- Low, M – Moderate (Medium), H - High

16PBS401 **PROBABILITY AND STATISTICS** Category: BS

L T P C

3 2 0 4

Pre-Requisites: Nil

Course Objectives:

- To gain the knowledge of probability concepts.
- To understand the statistical distributions both discrete and continuous cases.
- To be familiar with tests of sampling.
- To familiarize with design of experiments and correlation analysis.

UNIT- I	**PROBABILITY AND RANDOM VARIABLES**	**(9+6)**
Axioms of probability – conditional probability -Independent events – Total probability –Baye's theorem – Random variables – Discrete and continuous random variables – Moments – Moment generating functions and their properties.		
UNIT- II	**STANDARD DISTRIBUTIONS**	**(9+6)**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems) Chebychev's inequality (Simple problems).		
UNIT- III	**TEST OF HYPOTHESIS**	**(9+6)**
Large samples: Tests of means, variances and proportions. Small samples: Tests of means, variances and attributes using t, F, Chi Square distribution – Interval estimation for mean, standard deviation and proportion.		
UNIT- IV	**ANALYSIS OF VARIANCE**	**(9+6)**
One way classification, Two way classification and Latin Square design (Only problems).		
UNIT- V	**CORRRELATION ANALYSIS**	**(9+6)**
Coefficient of correlation – rank correlation – regression lines – Multiple and Partial correlation – Partial regression - Regression planes (Problems only).		

Contact Periods:

Lecture : 45 Periods **Tutorial : 30 Periods** **Practical : 0 Periods** **Total : 75 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Veerarajan T	*Probability and Random Processes (with Queueing Theory and Queueing Networks)*	*McGraw Hill Education (India)Pvt Ltd., New Delhi, Fourth Edition 2016.*

Reference Books:

1.Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2015.

2.Gupta S.P, "Statistical Methods", Sultan Chand & Sons, New Delhi, 2015.

3.Kandasamy, Thilagavathy and Gunavathy, "Probability and Random Process", S. Chand & Co, Ramnagar, New Delhi, Reprint 2013.

4.Trivedi K.S, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice Hall of India, New Delhi.

5.Hwei Hsu, "Schaum's outline series of Theory and Problems of Probability and Random Process",Tata McGraw Hill Publishing Co., New Delhi, 2015.

Course Outcomes:

On completion of this course, students will be able to

CO 1: Understand probability axioms and calculate expected values through moment generating functions.

CO 2: Understand probability distributions of discrete and continuous random variables.

CO 3: Understand tests of sampling for large and small samples.

CO 4: Acquire fluency in experimental design using criterion of ANOVA.

CO 5: Understand how to calculate coefficient of correlation, regression coefficients, multiple and partial correlation and regression plane.

Course Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	L	M	M						M		M		M
CO 2	H	H	L	M	M						M		M		M
CO 3	H	H	H	H	H	L	L		M		M		M		M
CO 4	H	H	H	H	H	M	M		M		H		M		M
CO 5	H	H	H	H	H	L	L		M		M		M		M
16PBS401	H	H	H	H	H	L	L		M		M		M		M

L- Low, M – Moderate (Medium), H - High

16PES402 **APPLIED ELECTRONICS AND MICROPROCESSOR** Category: ES

(Common to Production and Mechanical Engineering)

L	T	P	C
3	0	0	3

Pre-Requisite:

16PES105 – Basic of Electrical and Electronics Engineering.

Course Objectives:

- To equip the students with the basic knowledge of analog and digital electronic circuits and microprocessor.

UNIT- I	**ANALOG ELECTRONIC CIRCUITS**	**(09)**
Review of characteristics of transistors - Need for biasing – DC Load line analysis - Biasing of BJT- Types of Biasing - Fixed and Self biasing - RC Coupled amplifier - Class A Power amplifier - Class B pushpull amplifier - Distortion in amplifiers. Concept of feedback - Oscillators - Barkhausen criterion - RC phase shift oscillator - Hartley Oscillator - ColpittsOscillator.		
UNIT- II	**DIGITAL CIRCUITS**	**(09)**
Binary number system – AND, OR, NOT, NAND, NOR and XORgate – Combinational circuits - Adders and subtractors. Flip flops – RS flip flop, JK, D, T flip flops. A/D and D/A converters - weighted resistor DAC -R-2R ladder DAC - servo tracking A/D - successive approximation A/D converter -Dual slope ADC - Memories - ROM - EPROM – EEPROM-RAM.		
UNIT- III	**8085 ARCHITECTURE AND PROGRAMMING**	**(09)**
Block diagram of microcomputer – Architecture of 8085 – Pin configuration – Instruction formats - Instruction set –Addressing modes – Simple assembly language programs.		
UNIT- IV	**TIMING DIAGRAM AND INTERRUPTS**	**(09)**
Instruction cycle - machine cycle -Timing diagram: OP code fetch cycle, Memory and I/O read cycle, memory and I/O write cycle, interrupt acknowledge machine cycle. Interrupts - Hardware Interrupts - Vectored Interrupts - Non-vectored interrupts – Priority interrupts - Data transfer schemes - synchronous transfer, asynchronous transfer, interrupt driven transfer and DMA transfer.		
UNIT- V	**INTERFACING AND APPLICATIONS**	**(09)**
Interfacing of Input and output devices – Applications of microprocessor - Temperature control – Stepper motor control – Traffic light control- Digital clock- EPROM Programmer.		

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

Text Books

Author Name	Title of Book	Publisher, Year of Publication
S.Salivahanan, N.Sureshkumar and A.Vallavaraj	*Electronic Devices and Circuits*	*2nd Edition, Tata Mc Graw Hill, 2008*
Morris Mano M	*Digital Design*	*Prentice Hall Of India Pvt. Ltd. 2008*
Ramesh S. Goankar	*Microprocessor Architecture and Programming and Applications 8085 / 8080a*	*Penram International Publishing (India) 2004*

Reference Books:

1. *Mathur S.P., Kulshreshtha D.C., Chadha P.R. "Electronic Devices and Applications and Integrated Circuits", Umesh Publications, 2004.*
2. *Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085,8086, 8051 and 8096", PHI, 2011.Ajit Pal, "Microprocessor Principles and Applications", Tata Mcgraw Hill, New Delhi 1999.*
3. *Allen Mottershead "Electronic Devices and Circuits", Prentice Hall of India, 2008.*
4. *Charles H.Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishing House, 2006.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Knowledge about bipolar junction and field effect transistors.

CO2: Knowledge on the design of amplifiers and oscillators.

CO3: Knowledge about combinational and sequential logic circuits.

CO4: Basic knowledge about A/D and D/A converters.

CO5: In-depth knowledge on architecture and programming concepts of 8085 microprocessor.

CO6: Exposure to various interfacing circuits for real time applications.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H		L										L		L
CO 2	H		L										L		L
CO 3	H		L										L	L	L
CO 4	L												L	L	L
CO 5	M		M										L		L
CO6	M		M										L	L	L
16PES402	M		L										L	L	L

L- Low, M – Moderate (Medium), H – High

16PES403 **ELECTRICAL MACHINES AND DRIVES** Category: ES

(Common to Production and Mechanical Engineering) **L T P C**

3 0 0 3

Pre-Requisites:

16PES105- Basics of Electrical and Electronics Engineering

Course Objectives:

- To understand the fundamental of energy conversion and to study the construction, principal of operation, characterization of DC machines, AC machines and various drives used.

UNIT- I	**DC MACHINES**	**(10)**
Construction – Generator Principle – EMF equation – Characteristics of different types of DC generators – Motor principle – Torque equation – Characteristics of different types DC motors – Starters – Speed control – Electric braking – Swinburne's test – Brake test.		
UNIT- II	**SYNCHRONOUS MACHINES**	**(09)**
Alternators – Types and constructional features – EMF equation – Voltage regulation – Synchronous motor principle – V and inverted V curves – Hunting – Methods of starting – Applications.		
UNIT- III	**INDUCTION MACHINES**	**(10)**
Construction of three-phase induction motors – Principle of operation – Torque-slip characteristics – Starting and speed control methods – Single phase induction motor – Types – Methods of starting – Applications – Universal motor.		
UNIT- IV	**SOLID STATE SPEED CONTROL (Power circuits and Qualitative treatment only)**	**(08)**
Control of DC drives using rectifiers and choppers – Control of three phase induction motor using stator voltage control – V/f control– Rotor resistance control– Slip power recovery schemes.		
UNIT- V	**SELECTION OF DRIVES AND SPECIAL MOTORS**	**(08)**
Types of electrical drives – Factors influencing the choice of electric drives – Loading conditions and classes of duty – Determination of power rating – Selection of motor for steel rolling mills, paper mills, sugar mills, textile mills, and machine tool applications – DC and AC servomotors – Stepper motors.		

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

Text Books

Author Name	Title of Book	Publisher, Year Of Publication
Theraja B.L and Theraja A.K.	*A Test book of Electrical Technology, volume – II*	*S.Chand& Co., 2006*
Pillai S.K	*A first course on Electrical Drives*	*New Age International Publishers.,NewDelhi, 2nd Edition (Reprint) 2010*

Reference Books

1. *De N.K and Sen P.K., 'Electric Drives', PHI, 2009.*
2. *Deshpande M.V., 'Electric motors application and control', PHI, 2011.*
3. *Sugandhi R.K. and Sugandhi K.K., 'Thyristors: Theory and applications', New Age International Publishers, 2nd edition (reprint) 2009.*
4. *Dubey G.K., 'Fundamentals of Electric Drives', Alpha Science International Ltd., 2002.*
5. *Vedam Subramaniam., 'Electric Drives: Concepts and Applications', McGraw Hill, 2011.*

Course Outcomes:

On completion of this course, students will be able to

CO 1: Select and utilize various electrical machines

CO 2: Employ effective control techniques to electrical motors

CO 3: Identify suitable synchronous machines for real time applications

CO 4: Design suitable induction machines for real time applications

CO 5: Select appropriate electrical drive for various industrial applications

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	L	M	-	-	H	-	-	M	L	-	-	M	-	H	-
CO 2	L	-	M	-	-	-	-	M	-	M	-	M	M	-	-
CO 3	L	-	-	M	-	-	-	-	-	-	L	M	-	-	H
CO 4	-	H	-	-	-	-	-	-	-	-	H	M	-	M	-
CO 5	H	-	L	-	L	M	-	M	-	L	-	-	M	-	-
16PES403	L	M	L	M	M	M		M	L	L	M	M	M	M	H

L- Low, M – Moderate (Medium), H - High

16PPC404 **MECHANICS OF MACHINES** Category: PC

L T P C

3 2 0 4

Pre-Requisites:

1. 16PES206 – Engineering mechanics
2. 16PES302 – Strength of Materials

Course Objectives:

- To familiarize the basic concepts of mechanisms and machinery.
- To make the students to know the importance of balancing and the effect of friction and vibration in different machine parts.
- To make the students to learn about various gear train configurations and kinematic analysis of cam-follower motion.

UNIT- I	**MECHANISMS**	**(9+6)**
Machine structure - Kinematic link, pair and chain-Constrained motion- Degrees of freedom- Slider crank and crank rocker mechanisms - inversions, applications - Introduction to Kinematic analysis and synthesis of simple mechanisms - Determination of velocity and acceleration of simple mechanisms.		
UNIT- II	**FRICTION**	**(9+6)**
Types of friction - Friction in pivot, collar and thrust bearings - Plate and disc clutches - Belt (flat and V) and Rope drives - Ratio of tensions - Effect of centrifugal and initial Tension - Condition for maximum power transmission.		
UNIT- III	**GEARING AND CAMS**	**(9+6)**
Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – Cam – Types of cams and followers – Cam design for different follower motions.		
UNIT- IV	**BALANCING**	**(9+6)**
Static and dynamic balancing - Single and several masses in different planes - Primary and secondary balancing of reciprocation masses – Balancing of single and multi cylinder engines.		
UNIT- V	**VIBRATION**	**(9+6)**
Free, forced and damped vibration of single degree of freedom systems - force Transmitted to supports - vibration isolation - vibration absorption - torsional vibration of shaft – Single and multi rotor systems-Critical speed of shafts.		

Contact Periods:

Lecture : 45 Periods **Tutorial : 30 Periods** **Practical : 0 Periods** **Total : 75 Periods**

Text Books

Author Name	Title of Book	Publisher, Year Of Publication
Rattan, S.S.	*Theory of Machines*	*McGraw-Hill Education (I) Private Ltd., New Delhi, 2015*
Bansal Dr.R.K. and BrarDr.J.S.	*Theory of Machines*	*Laxmi Publications (P) Ltd., New Delhi, 2016*

Reference Books

1. *Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.*
2. *Thomas Bevan, 'Theory of Machines', 3rd Edition, CBS Publishers and Distributors, 2005.*
3. *Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.*
4. *Rao,J.S. and Dukkipati, R.V. "Mechanism and Machine Theory", Second Edition, Willey Eastern Ltd., 1992.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Explain the basics concepts of various mechanisms and to do velocity and acceleration analysis of simple mechanisms.

CO2: Describe the effect of friction on power transmission.

CO3: Discuss the basic principles of gears and cams.

CO4: Perform static and dynamic balancing of high speed rotary and reciprocating machines.

CO5: Analyze free and forced vibrations of machines, engines and structures.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H											M		
CO2	M	H											M		
CO3	M	H										L	M		
CO4	M	H										L	M		
CO5	M	H										L	M		
16PPC404	M	H										L	M		

L- Low, M – Moderate (Medium), H – High

16PPC405 **METAL FORMING PROCESSES** Category: PC

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To familiarize the basic principles of metal forming theory.
- To make the students to know various types of metal forming processes.
- To make the students to know recent advances in metal forming.

UNIT- I	**INTRODUCTION TO METAL FORMING**	**(09)**
Mechanical behavior of materials - Elastic and plastic deformation - Classification of Forming Processes - Temperature in metal working: hot and cold working - Introduction to the theory of plastic deformation.		
UNIT- II	**BULK DEFORMATION PROCESSES – FORGING AND ROLLING**	**(09)**
Principle – classification – equipment – tooling – processes parameters and calculation of forcesduring forging and rolling processes – Ring compression test - Post forming heat treatment – defects(causes and remedies) – applications – Roll forming.		
UNIT- III	**BULK DEFORMATION PROCESSES – EXTRUSION AND DRAWING**	**(09)**
Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod/Wire drawing – tool,equipment and principle of processes – defects – Tube drawing and sinking processes – Mannesmann process of seamless pipe manufacturing – Tube bending.		
UNIT- IV	**SHEET METAL FORMING PROCESSES**	**(09)**
Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process; Principles, process parameters, advantages, limitations and applications - Formability of sheet metals - Design considerations.		
UNIT- V	**SPECIAL FORMING PROCESSES**	**(09)**
Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking.Explosive forming – Electrohydraulicforming.		

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

Text Books

Author Name	Title of Book	Publisher, Year Of Publication
Narayanasamy R	*Theory of Metal Forming Plasticity*	*Narosa Publishers, New Delhi, 1999*
Nagpal G.R.	*Metal forming processes*	*Khanna publishers, New Delhi, 2004.*

Reference Books

1. *Mikell P. Groover, "Principles of Modern Manufacturing", Wiley India Private Limited, 2014.*
2. *Kalpakjian S. and Schmid S.R, "Manufacturing Processes for Engineering Material", Pearson, Chennai, 2009.*
3. *Juneja B.L., "Fundamentals of Metal forming Processes", New Age International (P) Ltd., Chennai, 2007.*

Course Outcomes:

On completion of this course, students will be able to

CO 1: Describe the principles and classification of metal forming.

CO 2: Explain the fundamentals of forging and rolling processes.

CO 3: Describe various methods of extrusion and drawing processes.

CO 4: Compare various sheet metal forming processes.

CO 5: Discuss recent advances in metal forming.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M												L		
CO2	M												L		
CO3	M						L						L		
CO4	M						L						L		
CO5	M											M	L		
16PPC405	M						L					M	L		

L- Low, M – Moderate (Medium), H - High

16PPC406 **MACHINE TOOLS AND PROCESSES** **Category: PC**

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To study different machine tools and machining operations.

UNIT- I	**FUNDAMENTALS OF METAL CUTTING**	**(09)**
Concepts of orthogonal and oblique cutting - Mechanics of chip formation - Types of chips produced in cutting - Cutting forces and power-Temperature in cutting- Machinability-Tool life - Wear and failure-surface finish and integrity- Cutting Tool Materials-cutting fluids.		
UNIT- II	**MACHINE TOOLS AND PROCESSES FOR PRODUCING ROUND SHAPES**	**(09)**
Engine Lathe – functions; work holding devices in lathe – functions – Chuck, Centre, Dogs, Steady Rest and Follower Rest; Mechanism of lathe – Apron, Feed, Tumbler Gear; various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning methods. Drilling machines – specifications, types - feed mechanism, operations – drill bit nomenclature.		
UNIT- III	**MACHINE TOOLS AND PROCESSES FOR PRODUCING VARIOUS SHAPES**	**(09)**
Milling – specifications – types - cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation - gear shaping and gear hobbing. Broaching – specifications, types, tool nomenclature, broaching operations. Shaper machine – block diagram – functions - Quick return mechanism.		
UNIT- IV	**ABRASIVE MACHINING AND FINISHING OPERATIONS**	**(09)**
Abrasives - bonded abrasives - Grinding process- wheel, gear grinding operations and machines - grinding fluids - Design Consideration for Grinding - Finishing operations: Lapping, Honing, Burnishing- economics of grinding and finishing operation.		
UNIT- V	**MACHINE TOOL STRUCTURE AND AUTOMATION**	**(09)**
Machine tools structures -erecting and testing of machine tools- Vibration and chatters in machining- Automation: Capstan and Turret lathe - single spindle and multi spindle automats - Swiss type and automatic screw machines-Feeding Mechanisms-Transfer mechanism-Tracer controller Mechanism.		

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

Text Books

Author Name	Title of Book	Publisher, Year Of Publication
Hajra Choudhry S.K. and Bose S.K.,	*Workshop Technology Vol II*	*Media Promoters and Publishers Pvt. Ltd., Bombay,12th edition, 2007.*
Sharma P.C.,	*A Text Book of Production Technology*	*S.Chand and Company Ltd., New Delhi, 10th Revised edition, 2010.*

Reference Books

1. *Khanna, O.P and Lal, M, "A Text book of Production Technology", Vol.II, DhanpatRai Publications (P) ltd.,1st Edition, 2009.*
2. *SeropeKalpakjian and Steven R.Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte Ltd, Delhi, 2009*
3. *Jain R.K. and Gupta S.C., "Production Technology", Khanna Publishers, New Delhi, 17th edition,2004.*
4. *HMT, "Production Technology", Tata McGraw Hill publishing co. ltd., 1st edition, 2008.*

Course Outcomes:

On completion of this course, students will be able to

CO 1:describe about various machining processes and cutting tools.

CO 2: explain the processes involved in production of round shaped components.

CO 3: explain the processes involved in production of prismatic and contour shapes.

CO4: discuss about various finishing operations.

CO 5: explain the machine tool structure and mechanisms of automation.

Course Articulation Matrix

PO/PSO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PSO**	**PSO**	**PSO**
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	H	L		L		L	L			L	L	M	M	L	
CO2	H		L		L	M	L	L	M		L	L	H		M
CO3	H		L		L	M	L	L	M		L	L	H		M
CO4	H		L		L	M	L	L	M		L	L	H		M
CO5	M	M	H	M	H	M	M	L	L	M	L	M	H	M	H
16PPC406	H	L	L	L	L	M	L	L	L	L	L	L	H	L	M

L – Low, M- Moderate (Medium), H - High

16PPC407 **MACHINE DRAWING** **Category: PC**

L	T	P	C
0	0	4	2

Pre-Requisites:

16PES107 - Engineering Graphics

Course Objectives:

- To provide hands on training on assembly drawing and impart knowledge on various types of machine parts & joints.
- To create knowledge about important features of assembled parts used in major engineering applications.

UNIT- I	**CONVENTIONS, ABBREVIATIONS AND SYMBOLS**	**(06)**
Interrupted views- Partial views of symmetrical objects- Conventional representation of intersection curves- Square ends and openings, adjacent parts- Common machine elements.		
UNIT- II	**FITS AND TOLERANCES**	**(09)**
Description of tolerances and grades- Types of fits and their description- Shaft and hole basis systems- Selection of fits from standard tables- Fits for different applications- Examples- Geometrical tolerances- Surface finish conventions.		
UNIT- III	**PREPARATION OF ASSEMBLY DRAWINGS AND COMPONENT DRAWINGS**	**(45)**
Cotter joint, Knuckle joint, Flange coupling, Universal coupling, Foot step bearing, Plummer block, Connecting rod ends, Cross heads, Screw jack, Lathe tailstock, Stop valves, Non-return valve.		

Contact Periods:

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 60 Periods** **Total : 60 Periods**

Text Books

Author Name	*Title of Book*	*Publisher, Year Of Publication*
Gopalakrishna K.R	*Machine Drawing in First Angle Projection*	*Subhas Stores, Bangalore, 2007*
Bhatt.N.D	*Machine Drawing*	*Charotar Publishing House Pvt. Ltd., 49th edition, 2013.*

Reference Books

1. *Gill.P.S., "Text Book of Machine Drawing", S.K.Kataria and Sons, Publishers and Distributors, Delhi, 2013.*
2. *PSG College of Technology, Design Data Book of Engineers by KalikathirAchchagam, 2012.*
3. *Narayana K.L., Kannaiah.P., VenkataReddy.K., "Machine Drawing", New Age International Publishers, 2009.*

Course Outcomes:

CO 1: Describe the conventions in assembly drawing

CO 2: Describe the Fits and Tolerances

CO 3: Describe the Geometric Dimensioning &Tolerancing

CO 4: Incorporate the parts for to assemble

CO 5: Construct an assembly drawing of various machine unit

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M				M			M	L	M		M	M		
CO2	M				H			M	M	M		M	M		
CO3	M				H				M	M		M	M		
CO4					M				L	M		M	M		
CO5	H				H	M		M	M	M			M		
16PPC407	M				H	M		M	M	M		M	M		

L- Low, M – Moderate (Medium), H - High

16PES408 ELECTRICAL MACHINES AND MICROPROCESSOR LABORATORY Category: ES

L T P C
0 0 4 2

16PES408 (A) ELECTRICAL MACHINES LABORATORY Category: ES

L T P C
0 0 2 1

Pre-Requisites:

16PES105 - Basics of Electrical and Electronics Engineering

Course Objectives:

- To give hands on training for measuring DC/AC electrical parameters by conducting basic tests on DC / AC machines and analyzing their performance.

LIST OF EXERCISES
1. O.C.C and load-test on separately Excited DC generator
2. O.C.C and load-test on DC shunt generator
3. Swinburne's test
4. Speed control of DC shunt motor
5. Load test on DC shunt motor
6. Load test on DC compound motor
7. Load test on DC series motor
8. Mechanical and iron losses of 3-phase induction motor
9. Load test on 3-phase induction motor
10. Load test on 1-phase induction motor
11. Regulation of 3-phase alternator by EMF & MMF methods
12. Load test on 3-phase alternator
13. Study of induction motor starters

Contact Periods:

Lecture : 0 Periods Tutorial : 0 Periods Practical : 30 Periods Total : 30 Periods

Course Outcomes:

On completion of this course, students will be able to

CO 1: Perform suitable experiments to analyze the performance of DC machines and AC machines.

CO 2: To understand the concepts of working principles of electrical machines.

CO 3: Select electrical machines for appropriate applications

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	L	-	-	-	M	-	-	M	L	M	-	H	L	-	L
CO 2	M	-	-	-	H	-	-	M	M	M	-	M	-	-	-
CO 3	L	-	-	M	-	-	-	H	-	-	-	L	L	-	L
16PES408A	L	-	-	L	H	-	-	M	M	M	-	M	-	-	-

L- Low, M – Moderate (Medium), H - High

16PES408 (B) MICROPROCESSOR LABORATORY Category: ES

L	T	P	C
0	0	2	1

Course Objectives:

- To develop good programming skill in 8085 microprocessor and its applications.

LIST OF EXERCISES

Programs using 8085 Microprocessor

1. 8-bit addition and subtraction.
2. 16-bit addition and subtraction.
3. 8-bit multiplication and division.
4. Factorial of a number.
5. Sorting of numbers in ascending and descending order.
6. Code converters.
7. Stepper motor control.
8. Rolling display.

Contact Periods:

Lecture : 0 Periods Tutorial : 0 Periods Practical : 30 Periods Total : 30 Periods

References:

1. *S.Salivahanan, N.Sureshkumar and A.Vallavaraj, "Electronic Devices and Circuits", 2nd Edition,TataMcGrawHill, 2008.*
2. *Ramesh S. Goankar, "Microprocessor Architecture and Programming and Applications 8085 / 8080a", Penram International Publishing (India) 2004 .*
3. *A.Nagoorkani, "8085 microprocessor and its applications", 3rd edition, RBA Publisher, 2013.*
4. *Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085,8086, 8051 and 8096", PHI, 2011.Ajit Pal, "Microprocessor Principles and Applications", Tata Mcgraw Hill, New Delhi 1999.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Exposure to 8085 microprocessor.

CO2: In-depth knowledge on programming concepts of 8085 microprocessor.

CO3: Exposure to real time applications of 8085.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	-	L	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	H	-	L	-	-	-	-	-	-	-	-	-	L	-	L
CO 3	H	-	L	-	-	-	-	-	-	-	-	L	L	-	L
16PES408B	H	-	L	-	L	-	-	-	-	-	-	L	-	-	-

L- Low, M – Moderate (Medium), H - High

16PHS501 **TOTAL QUALITY MANAGEMENT** Category: HS

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To impart knowledge to develop a product with the required quality at a reasonable price and to satisfy the requirements under various quality standards

UNIT- I	**INTRODUCTION**	**(09)**
Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers to TQM implementation.		
UNIT- II	**TQM PRINCIPLES**	**(09)**
Customer satisfaction - customer perception of quality - customer retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.		
UNIT- III	**STATISTICAL PROCESS CONTROL**	**(09)**
Seven old and new tools of quality - statistical fundamentals - population and sample – normal curve - control charts for variables and attributes- state of control and out of control - process capability - concept of six sigma.		
UNIT- IV	**TOOLS AND TECHNIQUES**	**(09)**
Benchmarking - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM) - pillars of TPM - Failure Mode Effective Analysis (FMEA) - Failure rate- types of FMEA - stages of FMEA.		
UNIT- V	**QUALITY SYSTEMS**	**(09)**
Need for ISO 9000 and other quality system - ISO 9001:2015 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits- integrating ISO 14000 with ISO 9000 – OSHSAS 18001.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Dale H.Besterfield	*Total Quality Management*	*Pearson Education, 2008.*
SubburajRamasamy	*Total Quality Management*	*Tata McGraw Hill, 2008.*

Reference Books:

1. *James R.Evans& William M.Lidsay, "The Management and Control of Quality", Thomson Learning, 2002.*
2. *Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.*
3. *Zeiri,"Total Quality Management for Engineers" Wood Head Publishers, 1991*
4. *P.N.Mukherjee"Total Quality Management",PHI Publishers,2006.*
5. *John.LHradesky "Total Quality Management Hand book" McGraw-Hill, 1995.*

Course Outcomes:

On completion of this course, students will be able to

CO1: apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.

CO2: apply the principle of TQM in industries.

CO3: apply the principle of statistical process control in industries.

CO4: select appropriate quality tools to meet industrial requirements.

CO5: implement appropriate quality standards for industries.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	H			M			L	L		L	L	M	L	M
CO2	L	H			M			L	L		L	L	M	L	M
CO3	L	H			M			L	L		L	L	M	L	M
CO4	L	H			M			L	L		L	L	M	L	M
CO5	L	H			M		L	L	L		L	L	M	L	M
16PHS501	L	H			M		L	L	L		L	L	L	L	M

L- Low, M – Moderate (Medium), H - High

16PPC502 **MACHINE ELEMENTS DESIGN** Category: PC

(Use of Approved Data Book is permitted) L T P C

3 2 0 4

Pre-Requisites:

1.16PES206 - Engineering Mechanics

2.16PES302 - Strength of Materials

3.16PPC404 - Mechanics of Machines

Course Objectives:

- To familiarize the various steps involved in the Design Process.
- To make the students to learn the designing procedure for shafts, energy storing elements and flexible elements like Belt, Pulley and chain etc.
- To train the students to design the different type of bearings and gears using standard procedure.

UNIT- I	**PRINCIPLES OF DESIGN**	**(9+6)**
Fundamentals of Machine Design - Phases of Design, Design Consideration - Standards and Codes - Selection of Materials - Design against Static and Dynamic Load - Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure - Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.		
UNIT- II	**SHAFTS AND BEARING**	**(9+6)**
Design of solid and hollow shafts based on strength, rigidity and critical speed. Sliding contact and rolling contact bearings.		
UNIT- III	**JOINTS, COUPLINGS AND SPRINGS**	**(9+6)**
Design of welded joints, Bolted joints (brackets) - Design of flange couplings - Design of helical and leaf springs.		
UNIT- IV	**FLEXIBLE ELEMENTS**	**(9+6)**
Selection of flat and V belts and pulleys. Roller chains.		
UNIT- V	**GEARS AND GEAR BOXES**	**(9+6)**
Design of spur and helical gears based on strength and wear considerations. Design of gear box: geometric progression - standard step ratio - ray diagram, kinematic layout - design of sliding mesh and constant mesh gear box.		

Contact Periods:

Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Bhandari V	*Design of Machine Elements*	*Tata McGraw-Hill Book Co,3rd Edition, 2010.*
Sharma, P.C., Aggarwal, D.K	*A Text Book of Machine Design*	*Kataria and sons., 2012*

Reference Books:

1. *Shigley, J.E., and Mischke, C.R., Mechanical Engg. Design, McGraw-Hill Book Co., 8th edition, 2008.*
2. *Dobrovolsky, V., and others, Machine Elements A Text Book, MIR Publishers.*
3. *Spotts, M.F., Design of Machine Elements (6th ed.), Prentice Hall of India Pvt.Ltd.*

Course Outcomes:

On completion of this course, students will be able to

CO 1: estimate safety factors of simple structures exposed to static and repeated loads.
CO 2: design the shafts and bearings.
CO 3: design the welded joints, bolted joints, couplings and springs.
CO 4: design the drives - chain drives and belt drives.
CO 5: design the spur gears, helical gears and gear boxes

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	L									L	M	M	H
CO2	M	H	L									L	H	M	H
CO3	M	H	L									L	H	M	H
CO4	M	H	L									L	H	M	H
CO5	M	H	L									L	H	M	H
16PPC502	M	H	L									L	H	M	H

L- Low, M – Moderate (Medium), H - High

16PPC503 COMPUTER NUMERICAL CONTROL MACHINES Category: PC

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PPC406 – Machine Tools and Processes

Course Objectives:

- To enable the students to understand CNC machines constructional features, working and programming.

UNIT- I	**INTRODUCTION TO CNC MACHINE TOOLS**	**(09)**
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, types of control systems, CNC controllers, characteristics, interpolators, types of CNC Machines – turning centre, machining centre, grinding machine, Vertical turret lathe, turn – mill centre, EDM.		
UNIT- II	**STRUCTURE OF CNC MACHINE TOOL**	**(09)**
CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.		
UNIT- III	**DRIVES AND CONTROLS**	**(09)**
Spindle drives, feed drives – stepper motor, servo principle, DC and AC servomotors, Linear motors. Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.		
UNIT- IV	**CNC PROGRAMMING**	**(09)**
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controller such as Fanuc, Sinumerik. - Generation of CNC codes from CAM packages.		
UNIT- V	**TOOLING AND WORK HOLDING DEVICES**	**(09)**
Cutting tool materials for CNC machine tools – hard metal insert tooling - inserts and tool holder classification - qualified, semi qualified and preset tooling, ATC, APC, tooling for Machining and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
HMT Limited	*Mechatronics*	*Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005*
Mike Mattson	*CNC Programming Principles and Applications*	*Delmar Cengage learning, 2010*

Reference Books:

1. *Evans K., Polywka J. and Stanley Gabrel., "Programming of CNC Machines", Third Edition – Industrial Press Inc, New York, 2007*
2. *Madison J., "CNC Machining Hand Book", Industrial Press Inc., 1996.*
3. *Smid P., "CNC Programming Hand book", Industrial Press Inc., 2007 Third Edition*
4. *Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2002.*
5. *Rao P.N., "CAD/CAM Principles and Applications", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the evolution and principle of CNC machine tools and types of control systems.

CO2: apply knowledge in current terminology to describe the CNC machines and its types.

CO3: describe constructional features of CNC machine tools, drives and positional transducers used in CNC machine tools.

CO4: generate CNC programs for popular CNC controllers.

CO5: describe tooling and work holding devices for CNC machine tools.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L				H								L		
CO2	L				H								L		
CO3	L				M								M		
CO4	L				H							M		H	
CO5	L				M								M		
16PPC503	L				H							M	M	M	

L- Low, M – Moderate (Medium), H – High

16PPC504 METROLOGY AND COMPUTER AIDED INSPECTION Category: PC

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To impart knowledge on different kind of traditional and latest computer aided measuring instruments with appropriate parameters of measuring components.

UNIT- I	**GENERAL CONCEPTS OF MEASUREMENT**	**(09)**
Definition – standards of measurement – accuracy and precision – errors in measurement –limits, fits and tolerances – interchangeability and selective assembly – calibration of instruments. Principles of light interference – measurements and calibration – Taylor's principle**s** - design of gauges.		
UNIT- II	**LINEAR AND ANGULAR MEASUREMENTS**	**(09)**
Linear measuring instruments : Vernier instruments, micrometers, height gauge, dial indicators, bore gauges, slip gauges, comparators. Angle measuring instruments : bevel protractors, sprit level, sine bar, autocollimator, angle dekkor and clinometers – interferometry.		
UNIT- III	**FORM MEASUREMENT**	**(09)**
Screw thread terminology- Measurement of effective diameter by two wire and three wire methods - errors in threads-Measurement of pitch, profile errors and total composite errors, Gear tooth terminology-Methods of measurements of runout, pitch, profile, lead, backlash, tooth thickness composite method of inspection - Parkinson gear tester, Measurement of surface finish - Stylus probe instruments - profilometer-Tomlinson and Talysurf instrument-Straightness, Flatness and Roundness measurement.		
UNIT- IV	**LASER METROLOGY**	**(09)**
Laser in engineering metrology – methods of laser metrology – precision instruments based on laser – laser interferometer – applications of laser in industry – linear and angular measurement – optical methods for fast non contact online measurement – scanning laser beam.		
UNIT- V	**COMPUTER AIDED INSPECTION**	**(09)**
Automated inspection - online and offline inspection, sensor technology for manufacturing process monitoring and inspection - flexible inspection systems – non contact inspection methods – automatic gauging and size control system – co ordinate measuring machine – non contact CMM using electro optical sensors for dimensional metrology – non contact sensors for surface finish measurements – machine vision systems and its applications.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Gupta. I.C	*A text bookof Engineering Metrology*	*Dhanpat Rai and Sons, Delhi, 2012.*
Groover M.P	*Automation, Production systems and Computer Integrated Manufacturing*	*Prentice Hall India Ltd.,*

Reference Books:

1. *Jain.R.K., "Engineering Metrology", Khanna Publishers, Delhi, 2015.*
2. *Gayler G.N., and Shotbolt C.R., Metrology for Engineers, ELBS Edn.,*
3. *ASTE hand book of industrial metrology, Predntice hall of India Ltd.,*
4. *Marvin J.Weber, Hand book of LASERS, CRC Press.*

Course Outcomes:

On completion of this course, students will be able to

CO1: understand the general concepts of linear and angular measurements.
CO2: describe various geometric and form measurements.
CO3: explain about recent measuring machines and advances in metrology.
CO4: describe various measurement concepts involved in laser metrology.
CO5: explain the basic concepts of computer aided inspection

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H			L								M	L		M
CO2	M	L		M								L	L		M
CO3	M			H								M	L		M
CO4	M		L	M								M	L		M
CO5	M		L	H								M	L		M
16PPC504	H	L	L									M	L		M

L- Low, M – Moderate (Medium), H - High

16PPC505 **FLUID POWER DRIVES AND CONTROLS** Category: PC

L T P C

3 0 0 3

Pre-Requisites:

1. 16PPC303 – Fluid Mechanics and Machinery
2. 16PPC405 – Metal Forming Processes
3. 16PPC406 – Machine Tools and Processes

Course Objectives:

- To make the students to design the hydraulic and pneumatic circuits for different applications.

UNIT- I	**BASIC PRINCIPLES**	**(09)**
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection, Pumping Circuits; Hydraulic actuators – Classification, Cylinder Mounting, Selection, Characteristics; Hydraulic valves – Pressure, Flow, Direction Controls, Applications, Symbols		
UNIT- II	**HYDRAULIC CIRCUITS**	**(09)**
Hydraulic circuits – Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Application circuits – Press, Milling Machine, Planner, Fork Lift, etc.		
UNIT- III	**POWER GADGETS IN HYDRAULICS**	**(09)**
Accumulators – Classification, Circuits; Pressure Intensifier and Circuit; Safety Circuits; Mechanical hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATIC SYSTEMS**	**(09)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls : Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGN AND SELECTION OF PNEUMATIC CIRCUITS**	**(09)**
Design of Pneumatic circuits – Classic, Cascade, Step counter, Combination methods; PLC and Microprocessors – Uses; Selection criteria for Pneumatic components; Installation and Maintenance of Pneumatic power pack; Fault finding; Case studies.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Anthony Esposito	*Fluid Power with Applications*	*Pearson Education India, 7th edition, 2013.*
Andrew Parr	*Hydraulics and Pneumatics : A Technician's and Engineer's Guide*	*Butterworth-Heinemann, 3rd edition, 2011.*

Reference Books:

1. *DudleyA Pease and John J Pippenger, Basic Fluid Power, Prentice Hall PTR, 2nd edition 1987.*
2. *John J Pippenger and Tyler G Hicks, Industrial Hydraulics,McGraw Hill,2nd edition, 1970.*
3. *J. Michael, Pinches and HohnG.Ashby, .Power Hydraulics., Prentice Hall, 1989.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the principle of fluid power

CO2: describe the components of hydraulics

CO3: design the hydraulic circuits for automation

CO4: describe the components of pneumatics

CO5: design the pneumatic circuits for automation

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M	L	L	H	M				L	L		L	
CO2	H	L		M	L	M	L		L			M	M	M	
CO3	M	H	H	L					L	M		M		L	M
CO4	H	L		M		M		L				M	L	M	
CO5	M	H	H		L		L		L			M		M	
16PPC505	M	M	H	M	L	M	L	L	L	L	L	M	L	M	L

L- Low, M – Moderate (Medium), H - High

16PPC507 MANUFACTURING PROCESSES LABORATORY I Category: PC

L T P C
0 0 4 2

Pre-Requisites:

16PPC406 - Machine Tools and Processes.

Course Objectives:

- To practice various machining operations in lathe.

LIST OF EXERCISES

1. Study of construction details of different types of lathes and tools
2. Study of various accessories used in lathe.
3. Study of different types of tools used in lathe and the measuring instruments
4. Exercises on models using conventional Lathes:
   - Facing, plain turning, step turning and parting
   - Groove cutting, knurling and chamfering.
   - Form turning and Taper turning
   - Thread cutting (Internal and external -Vee and square)
   - Eccentric turning
   - Drilling, reaming and counter sinking.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the constructional details of different types of lathe.

CO2: operate lathe and control the process parameters of machining.

CO3: perform plain turning, taper turning, eccentric turning etc.

CO4: perform external and internal thread cutting.

CO5: perform drilling, reaming on lathe.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H					L	L	L	H	H	M	L	M		M
CO2	H	H	M				M	L	H	H	M	L	M		M
CO3	H	H	H				M	L	H	H	M	L	M		M
CO4	H	H	H				M	L	H	H	M	L	M		M
CO5	H	H	H				M	L	H	H	M	L	M		M
16PPC507	H	H	H			L	M	L	H	H	M	L	M		M

L- Low, M – Moderate (Medium), H - High

16PPC508 **METROLOGY LABORATORY** Category: PC

L T P C
0 0 4 2

Pre-Requisites: Nil

Course Objectives:

- To familiarize the basic concepts of measurements, various linear, angular and form measuring equipment and their principles of operation.

LIST OF EXERCISES

1. Study and use of Measuring Instruments.
2. Calibration of Dial gauge using Dial Calibration Tester.
3. Measurement of external taper angle using sine bar and slip gauges.
4. Measurement of internal and external dovetail angle using rollers.
5. Measurement of internal angle using spheres.
6. Measurement of external angle using rollers and slip gauges.
7. Measurement of spur gear tooth thickness using gear tooth verniercaliper.
8. Measurement of internal diameter and depth of the cylinder using spheres.
9. Measurement of effective diameter and pitch of screw thread using three wire method and pitch gauge.
10. Optical profile projector - Measurement of gear tooth parameters and screw thread parameters.
11. Tool maker's microscope – Measurement of cutting tool geometry and screw threads parameters.
12. Straightness measurement using Autocollimator.
13. Study of Co-ordinate Measuring Machine.
14. Study of surfcorder for surface roughness measurement.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the general concepts of measurements.
CO2: apply and Identify correct symbols, abbreviations and units for all measurements.
CO3: perform some linear, angular and form measurements, and record observations.
CO4: calibrate the measuring instruments.
CO5: explain about various methods of traditional and modern measurements that are used in the industry to measure product dimensions.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L							M	L			L		M
CO2	L				L	L			M	L			L		M
CO3	L	H							M	L			L		M
CO4	L	H							M	L			L		M
CO5	L	H			M				M	L			L	M	M
16PPC508	L	H			L	L			M	L			L	L	M

L- Low, M – Moderate (Medium), H - High

16PPC601 **OPERATIONS RESEARCH TECHNIQUES** Category: PC

(Use of Approved Statistical Table is permitted) L T P C

3 2 0 4

Pre-Requisites:

16PBS401 – Probability and Statistics

Course Objectives:

- To provide an in-depth understanding of definition, scope, objectives, phases, models & limitations of operations research.
- To familiarize various tools of optimization, decision making and simulation, as applicable in particular scenarios in industry for better management of various resources.

UNIT- I	**LINEAR MODELS**	**(9+6)**
The phases of operations research study- formation of Linear programming model - Graphical method - Simplex algorithm – artificial variables technique - Big M method - Duality - Dual Simplex method.		
UNIT- II	**TRANSPORTATION, ASSIGNMENT AND SEQUENCING PROBLEMS**	**(9+6)**
Optimal solution by North West Corner method - Least Cost Method - Vogel's Approximation Method-optimality test – MODI method - Degeneracy. Assignment problem - formulation – Hungarian method – unbalanced assignment problem. Sequencing problem: processing 'n' jobs through two machines and three machines, processing two jobs through 'n' machines		
UNIT- III	**NETWORK MODELS**	**(9+6)**
Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling – Crashing.		
UNIT- IV	**QUEUEING THEORY AND SIMULATION**	**(9+6)**
Queueing models - Queueing systems and structures - Notation - parameter - Single Server and multi server models-Poisson input-exponential service –constant rate service- infinite population. Simulation- random number generation- application of simulation for queuing and maintenance		
UNIT- V	**DECISION MODELS**	**(9+6)**
Game theory – Two person zero sum games – Graphical solution- Algebraic solution. Replacement models - Replacement of items that deteriorate with time – value of money changing with time – not changing with time - optimum replacement policy – individual and group replacement.		

Contact Periods:

Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
P.K. Gupta and D.S. Hira	*Problems in Operations Research (Principles and Solutions)*	*S.Chand and Co. Ltd., 2013*
Panneerselvam, R	*Operations Research*	*2nd Edition, Prentice – Hall of India, New Delhi, 2006*

Reference Books:

1. *Taha H.A "Operations research", 8th Edition, Prentice – Hall of India, New Delhi, 2006.*
2. *Sharma S.D, " OperationsResearch"Kedarnath Ram Nath and Co.Meerut, 2009.*
3. *Don. T. Phillips, Ravindren A and James Solberg, "Opeartions research", John Wiley and sons, 1987.*

Course Outcomes:

On completion of this course, students will be able to

CO1: identify and formulate operational research models from the verbal description of a real system.

CO2: apply operations research techniques like L.P.P, Scheduling, Sequencing, Transportation problems to Industrial optimization problems.

CO3: use network scheduling techniques like PERT, CPM for solving project management problems.

CO4: analyze various models and apply suitable analytical method or simulation technique to solve queueing problems.

CO5: apply suitable decision making tools for Replacement and Game theory problems for achieving optimization.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M													M
CO2	M	H	M	L											M
CO3	M	H	L								H				M
CO4	M	H	M	L											M
CO5	M	H	M	L											M
16PPC601	M	H	M	L							H				M

L- Low, M – Moderate (Medium), H - High

16PPC602 **COMPUTER AIDED DESIGN** Category: PC

L T P C

3 0 0 3

Pre-Requisites :

1. 16PES107 - Engineering Graphics
2. 16PPC407 - Machine Drawing

Course Objectives:

- To make the students to gain exposure over the concepts of computer graphics.
- To familiarize the basics of CAD

UNIT- I	**FUNDAMENTALS OF COMPUTER GRAPHICS**	**(09)**
Introduction to Computer Aided Design (CAD) - conventional design vs CAD– Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation.		
UNIT- II	**GEOMETRIC MODELING**	**(09)**
Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).		
UNIT- III	**VISUAL REALISM**	**(09)**
Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – colouring – computer animation.		
UNIT- IV	**PART ASSEMBLY**	**(09)**
Mass properties - Assembly modeling – Inference of position and orientation –Geometric Dimensioning and Tolerancing – Functional importance of various types of fits, Geometrical dimensioning and Tolerancing, Tolerance stacking – types and remedies.		
UNIT- V	**CAD STANDARDS**	**(09)**
Standards for computer graphics- Graphical Kernel System (GKS) - Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, ACIS and DXF - communication standards.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Ibrahim Zeid and R. Sivasubramaniam	*CAD/CAM Theory and practices*	*Tata McGraw Hill, 2nd Edition, 2009*
Chris McMahon and Jimmie Browne	*CAD/CAM Principles, practice and manufacturing management*	*Pearson education Asia, 2001*

Reference Books:

1. *Rao, P.N., "CAD/CAM principles and applications" Tata McGraw Hill, 2012.*
2. *Donald D.Hearn, M.Pauline Baker and Warren Carithers "Computer Graphics with OpenGL", Pearson Education, 4th Edition, 2014.*

Course Outcomes:

On completion of this course, students will be able to

CO 1: explain the fundamentals of computer graphics.
CO 2: describe the basics of geometric modeling.
CO 3: discuss about visual realism in CAD.
CO 4: explain the importance of geometric dimensioning and tolerancing.
CO5: discuss about various computer graphics standards, data exchange standards and communication standards.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L			M									M	M
CO2	M	L			M									M	M
CO3	M				M									M	M
CO4	M	M			M							L		M	M
CO5	M				M							L		L	M
16PPC602	M	L			M							L		M	M

L- Low, M – Moderate (Medium), H – High

16PPC603 PROCESS PLANNING AND COST ESTIMATION Category: PC

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To introduce the process planning concepts, cost estimation for various manufacturing process.

UNIT- I	**INTRODUCTION TO PROCESS PLANNING**	**(09)**
Aims and Objectives, Place of process planning in Manufacturing cycle - Process and Production Planning. Drawing interpretation, Dimensional tolerance vs Production processes.		
UNIT- II	**PROCESS PLANNING STEPS**	**(09)**
Design of a process plan – Selection of production processes, tools and process parameters- Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan. Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches.		
UNIT- III	**INTRODUCTION TO COST ESTIMATION**	**(09)**
Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Cost ladder, Overhead expenses, Break-even analysis - Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis.		
UNIT- IV	**PRODUCTION COST ESTIMATION**	**(09)**
Estimation of production cost for - cast components, welded components, forged components, powder metallurgy parts.		
UNIT- V	**ESTIMATION OF MACHINING TIME AND COST**	**(09)**
Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping, Planing and Grinding, Cost estimation for machining processes.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Gideon Halevi	*Process and operation planning*	*Kluwer academic publishers (Printed ebook), 2003.*
M. Adithan.	*Process Planning and Cost Estimation*	*New Age International Publishers, 2007*

Reference Books:

1. *Thomas E.Vollmannet all, "Manufacturing Planning and Control Systems", GalgotiaPublications Pvt. Ltd., New Delhi, 1998.*
2. *Robert Creese, M. Adithan, B.S Pabla, "Estimating and Costing for the Metal Manufacturing Industries", Marcel Dekker, 1992.*
3. *Samuel Eilon, "Elements of Production Planning and Control", MacMillan, London, 1985.*
4. *Kesavan R "Process Planning and Cost Estimation", New Age International Pvt. Ltd., Chennai, 2008.*
5. *B.S. Narang, V. Kumar, "Production and Costing", Khanna Publishers, 2000.*
6. *Banga T R and Sharma S C, "Mechanical Estimating and Costing", Khanna Publishers, New Delhi*

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the concept of process planning and process selection.

CO2: describe the steps involved in process planning.

CO3: have a knowledge on cost estimation and f Break Even analysis.

CO4: estimate the manufacturing cost for welded, forged components and powder metallurgy parts.

CO5: calculate the machining time and cost for various machining process.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L							M	H	M					
CO2	M							M	H	M		M			
CO3	L							M	H	M		M			M
CO4	H								H	L			H		
CO5	H								H	M			H		
16PPC603	M							M	H	M		M	H		M

L- Low, M – Moderate (Medium), H – High

16PPC604 **JIGS, FIXTURES AND PRESS TOOLS** Category: PC

L T P C

3 0 0 3

Pre-Requisites:

1.16PPC405 - Metal Forming Processes

2.16PPC502 - Machine Elements Design

Course Objectives:

- To introduce the concepts of various types of jigs, fixtures and dies
- To design jig/ fixture / die for a given component

UNIT- I	**LOCATING AND CLAMPING DEVICES**	**(08)**
Principles of location and clamping – Different types of locating devices – different types of clamps – Drill bushes – types – Elements of fixtures – Materials used in jigs and fixtures.		
UNIT- II	**DESIGN OFJIGS**	**(10)**
Design concepts of Template Jig, Plate Jig, Sandwich Jig, Vice Jaw Jig, Latch Jig, Turnoverjig, Box jig – Design of simple jigs.		
UNIT- III	**DESIGN OF FIXTURES**	**(09)**
Fixtures for Milling, Grinding, Turning, Welding, and Assembly – Modular fixtures – Design of simple fixtures.		
UNIT- IV	**PRESS WORKING AND ELEMENTS OF DIE**	**(09)**
Blanking, Piercing, lancing, notching, bending design features of dies for drawing, extrusion and forging - Die block – Diesets - Die shoe – Bolster plate – punch – punch plate – punch holder – guide pins and guide bushes – strippers – knockouts – stops – pilots – Mechanism of Shearing – Centre of Pressure.		
UNIT- V	**DESIGN OF DIES**	**(09)**
Design considerations in extrusion, forging and bending dies — selection of standard die sets – striplayout and development - Design of Progressive die – compound die – Bending and cup drawing dies Milling fixtures.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Donaldson, B.H. Lecain, Goold V.V	*Tool Design*	*TMH Edition, 2012*

Reference Books:

1.Paquin, Die Design Fundamentals, Industrial Press Inc, New York, 2005 2.Fundamentals of Tool design, Society Of Manufacturing Engineers, 2010.

3. P.H.Joshi., Jigs and Fixtures, Mcgraw Hill Education, 2010.

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the fundamentals of work holding devices, locators and clamps.

CO2: discuss about various types of jigs and fixtures.

CO3: explain about various press working operations.

CO4: discuss about the various elements of die.

CO5: design simple dies/jigs/ fixtures for given component.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	M	M	M						L	M	L	M	L	M
CO2	M	H	M	L						L	M	L	M		M
CO3	M	M	L	L						L	M	L	M		M
CO4	M	M	M	L						L	L	L	L		M
CO5	M	H	H	M						L	L	L	M		H
16PPC604	M	H	M	L						L	M	L	M	L	M

L- Low, M – Moderate (Medium), H - High

16PPC607 MANUFACTURING PROCESSES LABORATORY II Category: PC

Pre-Requisites:

1. 16PPC406 - Machine Tools and Processes
2. 16PPC503 - Computer Numerical Control Machines

L	T	P	C
0	0	4	2

Course Objectives:

- To practice operations in radial drilling, shaper, grinder, milling machine and gear cutting with gear hobbing, gear shaping, milling and CNC machines.

LIST OF EXERCISES

- V-Groove cutting in shaping machine.
- Drilling, tapping and surface grinding using surface grinder and Radial drilling machine.
- External cylindrical grinding of shaft.
- Spur gear milling.
- Helical gear milling.
- Gear shaping.
- Gear hobbing.
- Polygonal milling.
- Making hexagonal hole using slotting machine.
- Letter cutting in vertical milling machine.
- Turning using Capstan and Turret lathes.
- Milling, Turning and drilling using CNC machining centre.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

Course Outcomes

On completion of this course, students will be able to

CO1: operate machines tools for various assembly and fabrication tasks and expose to time management.

CO2: prepare gears using forming and generating methods of gear manufacturing and CNC operation.

CO3: to set up machines like shaper, grinding and milling machine for various applications.

CO4: fabricate parts for equipments / tools used for project works.

CO5: prepare report on work done.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H	M		M		M	L	H	H	M	L	M	L	M
CO 2	H	H	M		H		M	L	H	H	M	L	M	H	M
CO 3	H	H	H				M	L	H	H	M	L	M		M
CO 4	H	H	H				M	L	H	H	M	L	M		M
CO 5	H	H	M				M	L	H	H	M	L	M		
16PPC607	H	H	H		L	L	M	L	H	H	M	L	M	L	M

L- Low, M – Moderate (Medium), H - High

16PEE608 **MODELLING LABORATORY** Category: EEC

L T P C

0 0 4 2

Pre-Requisites:

1. 16PES107 Engineering Graphics
2. 16PPC407 Machine Drawing

Course Objectives:

- To design the solid models by creating parts and assemble them with the aid of computers.

LIST OF EXERCISES

Exercises on modeling of mechanical components using packages like AutoCAD / Mechanical Desktop/Inventor/IDEAS/ Pro Engineer/CATIA/Unigraphics etc…

- Simple two dimensional geometry creations and modification using drafting module.
- Detailing and documentation of a typical production drawing
- Attributes and data extraction from a drawing
- Creation of simple solid models using CSG and B-rep Approach
- Surface Modeling
- External database connection
- Generation of working drawings of components and preparation of assembly models of Tail stock, Cranehook, Flanged coupling, Screw jack, Clapperbox, Universal coupling, Machine vice

Drill jig assembly by using the following techniques…

- Generation of surfaces of revolution
- Generation of surfaces of extrusion
- Generation of surfaces by skinning operation
- Generation of solid models using constructive solid geometry, method shading and rendering.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the basics of graphics generation, 2-Dimensional and 3-Dimensionalconcepts involved in Computer Aided Design.

CO2: use the commands to create, edit and dimension the 2D model in detail.

CO3: use the commands to create, edit and dimension the 3D surface model.

CO4: use the commands to create, edit and dimension the 3D solid model.

CO5: do the assembly of various solid models and create 3D assembly model.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M	M							L	L	L	
CO2	M	M	L	L	L								L	L	
CO3	M	M	L	L	L								L	L	
CO4	M	M	M	L	L								L	L	
CO5	H	M	M	L	L								L	L	
16PEE608	M	M	M	L	L							L	L	L	

L- Low, M – Moderate (Medium), H - High

16PEE609 **MINI PROJECT** Category: EEC

L T P C

0 0 8 4

Pre-Requisites: Nil

Course Objectives:

- To provide an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated continuously by a Committee constituted by the Head of the Department.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 120 Periods Total: 120 Periods

Course Outcomes

On completion of this course, students will be able to

CO1: practice acquired knowledge within the chosen area of technology for project development.

CO2: identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

CO3: reproduce, improve and refine technical aspects for engineering projects.

CO4: follow and value health, safety and ethical practices during project.

CO5: work as an individual or in a team in development of technical projects.

CO6: communicate and report effectively project related activities and findings.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	M		M		L			L		L	M	M	L	
CO2	M	H	H	M	H	M	L		H	L	H	M	H	H	H
CO3	H	H	H	M	H	M	L		H	L	H	H	H	H	H
CO4						M	L	H	L		H	L			
CO5									H	L	H	H	H	H	H
CO6									M	H	M	M			
16PEE609	M	H	H	M	H	M	L	H	H	H	H	H	H	H	H

L- Low, M – Moderate (Medium), H - High

16PPC701 **AUTOMATION AND CIM** Category: PC

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To provide knowledge on various automated manufacturing activities.
- To familiarize the application of computer Technology in the manufacturing activities.
- To enable the students to understand the smooth transition from conventional manufacturing to automated production and computer integrated manufacturing.

UNIT- I	**FUNDAMENTALS OF AUTOMATION AND CIM**	**(09)**
Concept of automation - Basic Elements of Automated system and Classification – Levels of Automation – Ten Strategies for Automation, Concept of automation in industry - classification, mechanization and automation. Evolution of CIM - CIM Hardware and Software – Data base Requirement of CIM – Concurrent engineering – Principles – Design and development. Production economics.		
UNIT- II	**AUTOMATION IN MANUFACTURING**	**(09)**
Automation in machine tools - Mechanical feeding and tool changing - machine tool control transfer automaton, automated flow lines - Methods of work part transport transfer - Line efficiency. Simulation in assembly line - Analysis of Automated flow lines - General terminology and analysis of transfer lines - without and with buffer storage, partial automation, Implementation of automated flow lines. Buffer stock - Mechanical buffer storage control function.		
UNIT- III	**AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS**	**(09)**
Storage system performance, Storage location strategies, Conventional storage methods and equipment. Automated storage systems-Automated Storage/Retrieval systems, Carousel storage systems. Engineering analysis of storage systems. Industrial Robot applications-Material handling, Processing operations, Assembly and Inspection.		
UNIT- IV	**GROUP TECHNOLOGY AND FMS**	**(09)**
Group Technology – Part families – Part Classification and Coding – Production flow Analysis – Cellular manufacturing – Cell design – Application considerations in Group Technology. Concepts of FMS – Comparison with Conventional Manufacturing – Economic Justification – Components of FMS – Types of Flexibility – FMS Applications and Benefits.		
UNIT- V	**CONTROL SYSTEMS**	**(09)**
Process industries and Discrete manufacturing industries – levels of automation, variables and parameters – Continuous control systems – Steady state optimization, Adaptive control - Computer process control – control requirements, capabilities and forms of computer process control – Computer process monitoring, Direct Digital Control, Distributed Control systems – Hardware components for automation and process control – Discrete process control – Logic control, Sequencing - Programmable Logic controllers.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Mikell P Groover,	*Automation, Production Systems and Computer Integrated Manufacturing*	*Pearson education (Singapore) Pvt. Ltd., New Delhi, 4th edition 2008.*
Radhakrishnan P and Subramaniyan S	*CAD/CAM/CIM*	*New Age International (P) Ltd., 3rd edition,2008.*

Reference Books :

1.*James A Rehg and Henry W Kraebber**, "Computer Integrated Manufacturing",3rd edition Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2005.*

2.Chris McMahon, and Jimmie Browne, "CAD/CAM Principles, Practice and manufacturing Management", Addison Wesley Longman Ltd, England, 2nd edition, 1998.

3.Kant Vajpayee .S, "Principles of Computer Integrated Manufacturing", Prentice Hall of India Limited,3rd edition 2010.

4.Paul G Rankey. "Computer Integrated Manufacturing". Prentice Hall, 2004

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the fundamentals of automation and CIM.
CO2: describe the automation in manufacturing.
CO3: describe the material handling and storage systems.
CO4: explain the concept of group technology and flexible manufacturing system.
CO5: describe the fundamentals of Control systems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	L	M	L			L			L	H	M	M
CO2	L	M	M	M	H	L			L		M	L	H	H	L
CO3	L	M	M	M	M	L			L		M	L	H	M	L
CO4	L	M	M	M	M	M			M		M	L	H	M	L
CO5	L	M	L	M	M	L			M	M	L		H	M	L
16PPC701	L	M	M	M	M	L			L	L	M	L	H	M	L

L – Low, M- Moderate (Medium), H - High

16PPC702 **PRODUCTION PLANNING AND CONTROL** Category: PC

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To study various production planning and control activities in industries.

UNIT- I	**INTRODUCTION**	**(09)**
Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification and specialization-Value analysis.		
UNIT- II	**WORK STUDY**	**(09)**
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation – Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.		
UNIT- III	**OPERATIONS PLANNING AND SCHEDULING**	**(09)**
Components of operations planning and scheduling systems – Aggregate planning – MPS – MRP – Capacity Planning, Process – Routing, Techniques – Scheduling, Principles, Types and Strategies Methodology - Dispatching-Progress reporting and expediting-Lead time, Techniques for aligning completion times and due dates		
UNIT- IV	**MATERIALS PLANNING AND CONTROL**	**(09)**
Materials Planning and control, scope, Techniques – Purchasing, Functions, Methods, Procedure, parameters, Supplier selection – Make or Buy Decision – Store and storekeeping, Codification, Functions, Organising, Methods, Accounts of stores, valuation methods, storage, protection and Interrelationship.		
UNIT- V	**THEORY OF CONSTRAINTS, PURCHASING AND DISTRIBUTION**	**(09)**
Fundamental Principles of the Theory of Constraints – Guidelines – Steps to improve the Process Using TOC Principles - Impact on Operations Strategy - General Types of Constraints Causes – Scheduling and TOC – Purchasing - information Issues, Responsibilities for material procurement – Distribution Requirements Planning.		

Contact Periods:

Lecture: 45Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Samson Eilon	*Elements of production planning and control*	*Macmillan, 1962.*
Stephen N. Chapman	*The fundamentals of production planning and control*	*Pearson education, 2009.*
Anil Kumar, Suresh	*Production and Operations Management*	*New Age international, 2008.*

Reference Books

1. MartandTelsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2011.

Course Outcomes

On completion of this course, students will be able to

CO1: distinguish manufacturing and service operations, and explain the overview of operations in an industry.

CO2: classify various forecasting techniques and identify strategies for sales and operations planning.

CO3: explain the methodology of scheduling and materials planning

CO4: describe the methodology of capacity planning and Production control

CO5: explain about the theory of constraints and significance of purchasing and distribution.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L							L	M	L			M
CO2	M	M		M	L					L	H	L			M
CO3	L	M	L	L	L					L	M	L			M
CO4	M	L	L	L	L					M	H	L			M
CO5	M	M	M	L	L					L	M	L			M
16PPC702	M	M	L	L	L					L	H	L			M

L- Low, M – Moderate (Medium), H - High

16PEE707 AUTOMATION AND CONTROL SYSTEMS LABORATORY Category: EEC

L T P C

0 0 4 2

Course Objectives:

- To train the students to simulate the simple applications in hydraulic and pneumatic kits.
- To train the students to control the speed of electrical drives.

1. Design and simulation of systems using single acting actuator and Pneumatic elements.
2. Design and simulation of system using double acting actuator, Pneumatic elements and Electro Pneumatic elements.
3. Design and simulation of system using double acting actuator and PLC.
4. Design and simulation of hydraulic system – sequencing circuit, air-oil intensifier circuit, meter-in and meter-out circuit.
5.Design and simulation of hydraulic system with PLC – sequencing circuit, meter-in and meter- out circuit, high-low circuit, on delay timer control circuit.
6. Speed control of AC motor.
7.Speed control of DC motor.
8. PID controller with temperature control system.
9. Servo controller using servo motor.
10. Stepper motor interfacing with 8051 micro-controller.
11. Computerized data logging system.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

Course Outcomes:
On completion of this course, students will be able to

CO1: design and develop the simple industrial application pneumatic circuits.
CO2: design and develop the simple industrial application hydraulic circuits.
CO3: explain PID controller with temperature control system.
CO4: control the speed of electrical drives.
CO5: activate the stepper motor interfacing with 8051 micro-controller.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M	M		M			L	L		L	H	M	L
CO2	M	H	M	M		L			L	L		L	H	M	L
CO3	L	M	H	M		L			L	L		L	H	M	L
CO4	L	M	L	M		L			L	L		L	H	M	L
CO5	L	M	M	M		L			L	L		L	H	M	L
16PEE707	L	M	M	M		L			L	L		L	H	M	L

L – Low, M- Moderate (Medium), H - High

16PEE708 **SIMULATION LABORATORY** Category: EEC

L	T	P	C
0	0	4	2

Pre-Requisites:

1.16PES302 Strength of Materials

2.16PPC502 Machine Elements Design

3.16PPE003 Finite Element Techniques

Course Objectives:

- To gain practical experience in handling 3D modeling and analysis software.

Finite Element Modeling and Analysis
• Exercises on Modeling and Meshing on 1D, 2D and 3D models. • Exercises on Solution and Post processing of 1D, 2D and 3D models. • Structural analysis of a fixed beam • Structural analysis of a cantilever beam • Structural analysis of a link element • Structural analysis of aluminium bracket • Modeling using axisymmetry • Plane stress analysis • Modeling of a spindle base • Modal analysis of cantilever beam • Modeling of allen key • Heat distribution in rectangular slab • Thermal analysis of 2D heat sink • Exercise on coupled field analysis
CAM software
• Designing of connecting rod using CAM software • Exercise on 2D part development and NC contour tool path generation.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

Reference Books

- Laboratory Manual prepared by Department of Production Engineering.

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the basics used to create and manipulate geometric models in computer using ANSYS.

CO2: create 1D, 2D and 3D models using ANSYS and Master CAM.

CO3: do structural and thermal analysis of various models.

CO4: describe about the failure criteria and vonmises stress for various models.

CO5: do the coupled field analysis involved in structural and thermal analysis simultaneously.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	M	M								L	M	
CO2	M	M	H	M	M								L	M	
CO3	M	M	H	M	M								L	M	
CO4	M	M	H	M	M								L	M	
CO5	H	H	H	M	M								L	M	
16PEE708	M	M	H	M	M								L	M	

L- Low, M – Moderate (Medium), H - High

16PEE801 **PROJECT WORK** Category: EEC

L	T	P	C
0	0	16	8

Pre-Requisites: Nil

Course Objectives:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

A project topic must be selected by the students in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and fabrication of a device for a specific application, a research project with a focus on an application needed by the industry/society, a computer project, a management project or a design project.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

Course Outcomes

On completion of this course, students will be able to

CO1: identify problem specification or need for development.

CO2: analyse and develop conceptual design and methodology of solution for the problem.

CO3: devise solution and build physical model /test if required, as per industry / research / societal need, with due consideration of environmental aspects.

CO4: follow and value health, safety and ethical practices during project.

CO5: contribute as an individual or in a team in development of technical projects.

CO6: express technical ideas, strategies and methodologies in written form.

CO7: develop effective communication skills for presentation of project related activities.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	M		M		L			L		L	M	M	L	
CO2	M	H	H	H	H	M	L		H	L	H	M	H	H	H
CO3	H	H	H	H	H	M	H		H	L	H	H	H	H	H
CO4						H	L	H	L		H	L			
CO5									H	L	H	H	H	H	H
CO6									M	H	M	M			
CO7									M	H	L	M			
16PEE801	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

L- Low, M – Moderate (Medium), H - High

16PPEX01 **MECHATRONIC SYSTEMS** Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PES402 Applied Electronics and Microprocessor
2. 16PPC505 Fluid Power Drives and Controls

Course Objectives:

- Introducing the key elements of mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT- I	**MECHATRONICS SYSTEMS**	**(09)**
Introduction to Mechatronics - Basics of actuating systems. Mechanical, pneumatic, hydraulics, electrical systems- control systems- measurements systems - Mechatronics approach.		
UNIT- II	**SENSORS AND TRANSDUCERS**	**(09)**
Introduction - performance terminology- displacement, position and proximity- velocity and motion- fluid pressure-temperature sensors- light sensors- selection of sensors- signal processing.		
UNIT- III	**8085 MICROPROCESSOR**	**(09)**
Introduction- architecture- pin configuration- instruction set- programming of microprocessors using 8085 instructions-interfacing input and output devices- interfacing D/A converters and A/D converters- applications- temperature controls-stepper motor control- traffic light controller.		
UNIT- IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**(09)**
Introduction- basic structure- input/output processing- programming- Mnemonics- timers, internal relays and counters-data handling- analog input/output- selection of a PLC.		
UNIT- V	**DESIGN OF MECHATRONIC SYSTEMS**	**(09)**
Stages in designing Mechatronics systems - Traditional and Mechatronics design- Possible design- solutions- case studies of Mechatronics systems- pick and place robots- automatic car park systems- engine management systems.		

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
W.Bolton	*Mechatronics*	*Pearson education., Second Edition, 2007.*
Ramesh S. Gaonkar	*Microprocessor Architecture. , Programming and Applications*	*Wiley Eastern, 1991.*

Reference Books:

1. *Michel B. Histand and David G. Alciatore, .Introduction to Mechatronics and measurement systems., McGraw Hill Intrenational Editions.*
2. *HMT Ltd, .Mechatronics., Tata McGraw Hill publishing Co. Ltd.*
3. *D.A.Bradley, D. Dawson, N.C. Buru and A.J. Loader. .Mechatronics., Chapman and Hall.*
4. *K. Ram, .Fundamantals of Microprocessors and Microcomputers.,Dhampat rai publications.*
5. *Dan Necsulescu, "Mechatronics", Pearson Education Asia. (Indian reprint).*

Course Outcomes:

On completion of this course, students will be able to

CO1: build the basic block diagram of mechatronics system (sensing, measuring controls and actuation, hardware and software).

CO2: describe the mechatronic system approach.

CO3: explain the concepts of transducers, sensors, microprocessor and programmable logic controllers in mechatronics systems.

CO4: identify critical problems/ design issues and suggest feasible solutions in mechatronics systems.

CO5: design mechatronic components and systems.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M	M	L						L	L	M	
CO2	M	M	M	M	M	L						L	L	M	
CO3	M	M	M	M	M	L						L	L	M	
CO4	M	M	H	H	M	L						L	L	M	
CO5	H	H	H	H	M	L						L	L	M	
16PPEX01	H	H	H	H	M	L						L	L	M	

L- Low, M – Moderate (Medium), H - High

16PPEX02 **ROBOTICS AND MACHINE VISION SYSTEM** Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To familiarize students with the concepts and techniques of robot manipulator, its kinematics, programming and build confidence to evaluate, choose and incorporate robots in engineering systems.

UNIT- I	**FUNDAMENTALS OF ROBOT**	**(09)**
Robotics – Introduction – Basic structure – Classification of robot and Robotic systems – Specifications of Robots - laws of robotics – work space, precision movement. Drives and Controls systems: Hydraulic systems, power supply – servo valve – hydraulic motor – DC servo motors – stepper motors – operation – selection of system – control system – servo control.		
UNIT- II	**ROBOT MOTION ANALYSIS**	**(09)**
Kinematics of Robot : Introduction, Matrix Representation, homogeneous transformation, forward and inverse kinematics, Inverse kinematics Programming, Degeneracy, dexterity, velocity and static forces, Basics of trajectory planning.		
UNIT- III	**GRIPPERS AND SENSORS**	**(09)**
Robot end effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of grippers – Vacuum cups – Magnetic grippers – Adhesive grippers – Robot end effectors interface. Sensors : Position sensors – Potentiometers, encoders, - LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors.		
UNIT- IV	**PROGRAMMING AND APPLICATION**	**(09)**
Types of programming – programming languages sample program for different types of robots – Industrial Applications: Application of robots in processing operations – Assembly and inspections – Material handling – Loading and unloading– AI and Robotics.		
UNIT- V	**MACHINE VISION**	**(09)**
Introduction – image processing Vs image analysis, image acquisition, digital images – sampling andquantization – image definition, levels of computation. Image processing Techniques: Data reduction –Windowing, digital conversion. Segmentation– Thresholding, Connectivity, Noise reduction, Edge detection, Segmentation, Region growing and Region splitting, Binary morphology and grey morphology operation – feature extraction.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Saeed B.Niku	*Introduction to Robotics: Analysis, Systems, Applications*	*2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)*
M.P.Groover	*Industrial Robotics – Technology, Programming and Applications*	*McGraw- Hill, USA, 1986*

Reference Books:

1. *Janakiraman P.A., Robotics and image processing, Tata McGraw Hill, 1995.*
2. *YoremKoren, Robotics for Engineers, McGraw-Hill, USA, 1992.*
3. *Richard D.Klafter, Thomas A.Chmielewski and Michael Negin, Robotic Engineering – An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.*
4. *Ramesh Jam, RangachariKasturi, Brain G.Schunck, Machine Vision, Tata McGraw Hill.*

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the basic concepts like various configurations, classification and parts of robots.

CO2: explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

CO3: describe various end effectors (grippers and tools) and sensors used in robots.

CO4: explain the concept of Artificial Intelligence in robots, various types of robot programming and its applications.

CO5: demonstrate the image processing and image analysis techniques by machine vision system.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L									L	M		
CO2	M	M	M	M								L	M		
CO3	M	L	L									L	M		
CO4	M	M	H		M							L	M	M	
CO5	H	M	M	L								L	M	M	
16PPEX02	M	M	M	L	L							L	M	M	

L- Low, M – Moderate (Medium), H - High

16PPEX03 **FINITE ELEMENT TECHNIQUES** Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PES302 – Strength of Materials
2. 16PPC502 – Machine Elements Design

Course Objectives:

- To familiarize the students in principles involved in discretization, finite element approach and can solve the simple engineering problems.

UNIT- I	**INTRODUCTION TO FINITE ELEMENT METHOD (FEM)**	**(09)**
Historical background; Basic concept of FEM; Discrete and continuous models; Boundary and Initial value problems; Discretization - Convergence requirements.		
UNIT- II	**FORMULATION OF ELEMENT CHARACTERISTIC MATRICES**	**(09)**
One dimensional governing equations - Structural and heat transfer problems; Variational method; Weighted residual methods; Principle of minimization of potential energy.		
UNIT- III	**ONE DIMENSIONAL PROBLEMS**	**(09)**
Shape functions; Problems in axial loaded members, trusses, beams, heat transfer through composite walls and fins; Gauss elimination and Cholesky method of solving equations.		
UNIT- IV	**TWO DIMENSIONAL PROBLEMS**	**(09)**
Linear triangular and rectangular elements – Shape functions:Pascal's triangle - Concept of plane stress and plane strain. Solution of simple problems in structural and heat transfer models.		
UNIT- V	**HIGHER ORDER ELEMENTS**	**(09)**
Applications of higher order elements; Lagrangian and serendipity elements; Isoparametric elements - Jacobian transformation.		

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
J.N.Reddy	*Introduction to Finite Element Method*	*McGraw Hill, Intl, 3rd edition, 2006.*
Larry J. Segerlind	*Applied Finite Element Analysis*	*John Wiley and Sons., 2nd edition, 1985.*
SingiresuS.Rao	*The Finite Element Method in Engineering*	*Butterworth Heinemann., 5th edition, 2011.*

Reference Books:

1. *Tirupathi R. Chandrupatala and Ashok D. Belegundu, Introduction to Finite Elements in Engineering, Pearson Education, 4th edition, 2011.*
2. *David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill, 3rd edition, 2005.*
3. *ChandrakantS.Desai, Elementary Finite Element Method, Prentice Hall Inc., 1979.*
4. *Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.*
5. *Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe the fundamentals of finite element technique
CO2: Formulate the structural and heat transfer problems
CO3: Solve the simple structural and heat transfer problems
CO4: Describe the shape function and element characteristics
CO5: Describe the higher order elements

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M				M					M		M	
CO2	M	M	L	M			L			M		L		M	
CO3	M		M	M			M			M		L		H	
CO4	M	M		M						H		M		H	
CO5	M	M	L							L		L		M	
16PPEX03	M	M	L	M			M			M		L		M	

L- Low, M – Moderate (Medium), H - High

16PPEX04 PRODUCTION OF AUTOMOTIVE COMPONENTS Category: PE

Pre-Requisites:

1. 16PPC305 – Foundry and Welding Technology
2. 16PPC306 – Engineering Metallurgy
3. 16PPC406 - Machine Tools and Processes

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students in functional requirements, need based materials and suitable manufacturing processes to produce the automobile components.

UNIT - I	**CYLINDER BLOCK**	**(09)**
Structure and functions – types – materials – sand casting of cast iron cylinder block- modification and machining - sand, gravity and low pressure casting methods of aluminium cylinder blocks – cylinder liners. Cylinder head – material – construction - heat treatment. Oil pan – function and materials.Gaskets – functions - materials and types.		
UNIT - II	**ENGINE PARTS**	**(09)**
Piston parts - Functions – materials – casting of piston by gravity casting and squeeze casting – modification and heat treatment – machining. Piston rings – Types - materials – functions –piston ring manufacturing. Piston pin types - materials. Forgings ofcrankshaft,connecting rod and gudgeon pins.		
UNIT - III	**VALVES AND ACCESSORIES**	**(09)**
Valve – types – Mechanisms - Materials - production methods - production of push rod, rocker arm and tappets. Camshaft- function and materials – chilled cast iron casting process – finishing operations – production of assembled camshaft - production of propeller shaft.		
UNIT - IV	**CLUTCH,GEARBOX AND BRAKES**	**(09)**
Clutch system, friction lining materials, requirements and manufacturing. Casting of gear box casing, precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of gears, heat treatment and finishing.Braking system - Types- manufacturing methods.		
UNIT - V	**BODY PANELS,SUSPENSION AND MISCELLANEOUS**	**(09)**
Principles of hydroforming - press forming - welding of body panels - resistance welding.Forging of front and rear axles, casting of rear axle casing– leaf spring materials and manufacturing - Manufacturing details - Construction details of wheel mounting –tyres and tube manufacturing - Mechatronics in automobile - Use of plastics in automobile components -Application of sensors and actuators - Automotive quality management system – ISO / TS 16949.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Kirpal Singh	*Automobile Engineering, Vol I and II*	*Standard Publishers., 12th edition, 2011.*
William H.Crouse and Anglin	*Automotive Mechanics*	*McGraw Hill Book Co., 10th edition, 2008*
Helt P.M.	*High speed combustion engines*	*Oxford and IBM Publishers Co. 1990*

Reference Books:

1. *Newton and Steels, .The motor vehicle. ELBS, 12th edition, 1998.*
2. *Narang G.B.S, Automobile Engineering, Khanna Publishers, 1991.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the major casting methods of cast iron and aluminium cylinder block.

CO2: describe the manufacturing methods of engine parts.

CO3: select the suitable material with respect to the functional requirement.

CO4: explain the fuel and transmission system.

CO5: explain the brakes, suspension and engine management systems.

CO6: identify suitable processes for the automobile parts according to the functional requirement.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	P0 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	M	H	H			M	M	H	H	H	L
CO2	H	H	H	H	M	H	H			M	M	H	H	H	L
CO3	H	H	H	H	M	H	H			M	M	H	H	H	L
CO4	H	H	H	H	M	H	H			M	M	H	H	H	L
CO5	H	H	H	H	M	H	H			M	M	H	H	H	L
CO6	H	H	H	H	M	H	H			M	M	H	H	H	L
16PPEX04	H	H	H	H	M	H	H			M	M	H	H	H	L

L- Low, M – Moderate (Medium), H - High

16PPEX05 UNCONVENTIONAL MANUFACTURING PROCESSES Category: PE

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To understand the working principles of various non-traditional machining processes, applications, advantages and limitations.

UNIT- I	**MECHANICAL ENERGYMETAL REMOVAL PROCESSES**	**(09)**
Need of modern machining processes – classification and selection of technology. Mechanical processes - Abrasive jet machining (AJM), water jet machining (WJM), Abrasive water jet machining (AWJM), Ultrasonic machining (USM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- II	**ELECTROCHEMICAL AND CHEMICAL METAL REMOVAL PROCESSES**	**(09)**
Electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring and honing – chemical machining (CHM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- III	**THERMAL METAL REMOVAL PROCESSES**	**(09)**
Electric discharge machining (EDM), wire cut electric discharge machining (WEDM), Plasma arc machining (PAM), Electron beam machining (EBM), Laser beam machining (LBM), Ion beam machining (IBM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- IV	**FORMING PROCESSES AND FOUNDRY TECHNIQUES**	**(09)**
Explosive forming, Electro – hydraulic forming, electro – magnetic forming. Dynapak machine - high pressure moulding, squeeze casting, vacuum castings.		
UNIT- V	**RAPID PROTOTYPING**	**(09)**
Introduction – advantages – limitations – principle. Rapid prototyping systems – stereo-lithography(SLA), selective laser sintering(SLS), fused deposition modeling(FDM), laminated object manufacturing (LOM), solid ground curing (SGC), three dimensional printing. Application of reverse engineering in rapid prototyping.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
P.C.Pandey	*Modern machining processes*	*Tata McGraw Hill publishing company Ltd. 2008.*
P.C.Sharma,	*A text book of Production Technology*	*S.Chand& Company Ltd. 2009.*

Reference Books:

1. *Bhattacharya, "New Technology", Institution of Engineers, 1997.*
2. *Gary.F.Benedict, "Nontraditional machining Processes", Marcell Dekker Inc, 2001*
3. *HMT, "Production Technology", Tata McGraw Hill Publishers, 2001.*
4. *V.K.Jain, "Advanced Machining Process",Allied Publishers PVT Ltd 2007*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the mechanical energy based newer production processes.

CO2: describe the electrochemical energy based newer production processes.

CO3: describe the thermal energy based newer production processes.

CO4: explain the explosive forming and high pressure casting processes.

CO5: describe various Rapid Prototyping techniques

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	H		M	M				M	L	L	L	H		L
CO2	M	H		M	M				M	L	L	M	H		L
CO3	M	H		M	L				M	L	L	M	H		L
CO4	M	H		M	L				M	L	L	M	H		L
CO5	L	H		M	L				L	L	L	M	H		L
16PPEX05	M	H		M	L				M	L	L	M	H		L

L – Low, M- Moderate (Medium), H - High

16PPEX06 **ADDITIVE MANUFACTURING** Category: PE

(Common to Production and Mechanical Engineering) L T P C

Pre-Requisites: 3 0 0 3

1. 16PPC405 -Metal Forming Processes
2. 16PPC406 - Machine Tools and Processes
3. 16PPC602 – CAD/CAM

Course Objectives:

- To educate students with fundamental and advanced knowledge in the field of Additive Manufacturing technology and the associated Aerospace, Architecture, Art, Medical and Industrial applications.

UNIT- I	**INTRODUCTION**	**(09)**
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes – Benefits – Applications. Software for AM- Case studies.		
UNIT- II	**REVERSE ENGINEERING AND CAD MODELING**	**(09)**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation.		
UNIT- III	**LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS**	**(09)**
Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and application. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications.		
UNIT- IV	**POWDER BASED ADDITIVE MANUFACTURING SYSTEMS**	**(09)**
Selective Laser Sintering (SLS): Principle, process, indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – case Studies, Selective Laser Melting and Electron Beam Melting		
UNIT- V	**OTHER ADDITIVE MANUFACTURING SYSTEMS**	**(09)**
Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, Demerits, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Bio Additive Manufacturing.		

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Chua Chee Kai and Leong Kah Fai	*Rapid Prototyping: Principles and Applications in Manufacturing*	*John Wiley AND Sons, 1997*
Paul F. Jacobs	*Stereo-lithography and other RP & M Technologies*	*from Rapid Prototyping to Rapid Tooling, SME/ASME,1996*

Reference Books:

1. *Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.*
2. *Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.*
3. *Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.*
4. *Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.*
5. *Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.*

Course Outcomes:

On completion of this course, students will be able to

CO1: appreciate the importance of computers and modern tools in manufacturing to reduce cost and matching the societal needs.

CO2: create and analyze 2D and 3D models using CAD modeling software and integrating with manufacturing systems.

CO3: understand the variety of Additive Manufacturing (AM) technologies apply to their potential to support design and manufacturing, case studies relevant to mass customized manufacturing.

CO4: apply knowledge on latest techniques of manufacturing in their field of career

CO5: to monitor and control shop floor with the aid of computers

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			L				M						L	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
16PPEX06		M	M		M	L	L				L		M	M	L

L- Low, M – Moderate (Medium), H – High

16PPEX07 **POWER PLANT ENGINEERING** Category: PE

(Common to Production and Mechanical Engineering) L T P C

3 0 0 3

Pre-Requisites:

16PES304 -Thermal Sciences

Course Objectives:

- To learn the economics of power generation.
- To understand the working of power plants and its comparative analysis.

UNIT- I	**ECONOMICS OF POWER GENERATION**	**(09)**
Load and load duration curves. Electricity billing – costing of electrical energy – Tariff structures. Economics of power plant – Fixed and variable cost. Payback period. Net Present Value, Internal Rate of Return. Emission calculation and carbon credit.		
UNIT- II	**HYDRO POWER PLANTS**	**(09)**
Energy scenario – Global and National. Essential elements and classification of hydro power plants. Typical Layout and associated components. Selection of turbines. Pumped storage plants.		
UNIT- III	**THERMAL AND GAS TURBINE POWER PLANTS**	**(09)**
Cycle analysis - Layout of modern coal based power plant. Super Critical Boilers - FBC Boilers. Subsystems – Water and Steam, Fuel and ash handling, Air and Gas, Draught system. Diesel and Gas Turbine power plants- Layout and Functioning. Environmental impact and Control.		
UNIT- IV	**NUCLEAR POWER PLANTS**	**(09)**
Layout and subsystems. Fuels and Nuclear reactions. Boiling Water Reactor, Pressurized Water Reactor, Fast Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors – working and Comparison. Safety measures. Environmental aspects.		
UNIT- V	**RENEWABLE ENERGY POWER PLANTS**	**(09)**
Solar power plants – Photovoltaic and Thermal. Wind power plants – Vertical and Horizontal axes Wind Turbines. Biomass power plants – Gasification and combustion. Tidal and Ocean Thermal Energy plants. Geothermal plants. Fuel cell – Types. Hybrid power plants.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
G.R. Nagpal	*Power Plant Engineering*	*Khanna publishers, 2012*
S.C. Arora and S. Domkundwar	*A Course in Power Plant Engineering*	*Dhanpat Rai and sons, 2014.*

Reference Books:

1. *P.K.Nag, "Power Plant Engineering", Tata McGraw Hill, 2014.*
2. *Paul Breeze, "Power Generation Technologies", Elsevier Ltd., 2014.*
3. *M.M.El.Wakil, "Power Plant Technology", Tata McGraw Hill, 2010.*
4. *R.K. Rajput, "A Textbook of Power Plant Engineering", Laxmi Publications pvt ltd, 2016.*
5. *James Momoh, Smart Grids - Fundamentals of Design and analysis, Wiley Press, 2012.*

Course Outcomes:

On completion of this course, students will be able to

CO1: arrive at cost of power generation, electricity billing and rate of return on power plant investments.

CO2: understand the working of Hydro-electric power plants.

CO3: analyze the working of Conventional power plants such as Thermal and Gas Turbines.

CO4: understand the working of nuclear power plants and its functional components.

CO5: understand the different types of renewable energy systems and its functional components.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L	H	M	H	L	M	L	L	L	M	H	M		M
CO 2	L	M	H	L	M	L	H	M	M	L	H	L	L		M
CO 3	M	M	H	M	M	H	M	L	L	H	M	M	M		L
CO 4	H	M	L	M	H	M	L	M	L	H	H	M	M		M
CO 5	M	L	L	H	M	M	L	H	H	M	H	H	M		M
16PPEX07	M	M	M	M	M	M	M	M	M	M	H	M	M		M

L- Low, M – Moderate (Medium), H - High

16PPEX08 **ROBUST DESIGN** Category:PE

(Common to Production and Mechanical Engineering)

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PES206 -Engineering Mechanics

Course Objectives:

- To impart knowledge to design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods.

UNIT- I	**EXPERIMENTAL DESIGN FUNDAMENTALS**	**(09)**
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot and linear regression models.		
UNIT- II	**SINGLE FACTOR EXPERIMENTS**	**(09)**
Completely randomized design, Randomized block design, Latin square design - Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests		
UNIT- III	**MULTIFACTOR EXPERIMENTS**	**(09)**
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F - tests. 2K factorial Experiments		
UNIT- IV	**SPECIAL EXPERIMENTAL DESIGNS**	**(09)**
Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods		
UNIT- V	**TAGUCHI METHODS**	**(09)**
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi - response optimization		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
A. Mitra	*Fundamentals of Quality Control and Improvement*	*Pearson Publication, 1998*
Phillip J.Rose	*Taguchi techniques for quality engineering*	*McGraw Hill, 1996*

Reference Books:

1. *Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.*
2. *Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.*
3. *NicoloBelavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.*
4. *J. Krottmaier, Optimizing Engineering Design, McGraw Hill Ltd, 1993*
5. *MadhavShridharPhadke, Quality Engineering Using Robust Design, Prentice Hall, 1985*

Course Outcomes:

On completion of this course, students will be able to

CO1: select appropriate tools for robust design.

CO2: identify and implement single factor experiments

CO3: identify and implement multi factor experiments

CO4: apply the concepts of .special experiment designs

CO5: apply the concepts of Taguchi experiment design for practical problems.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	L	M	H		L				L		L		L	L	L
CO 2	L	M	H		L				L		L		L	L	L
CO 3	L	M	H		L				L		L		L	L	L
CO 4	L	M	H		L				L		L		L	L	L
CO 5	L	M	H		L				L		L		L	L	L
16PPEX08	L	M	H		L				L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

16PPEX09 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING

Category: PE

Pre-Requisites: L T P C

1. 16PPC702 Production Planning and Control 3 0 0 3

Course Objectives:

- To introduce the concept of SQC, understand process control, acceptance sampling procedure and to learn the concept of reliability.

UNIT- I	**INTRODUCTION AND PROCESS CONTROL FOR VARIABLES**	**(09)**
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart.		
UNIT- II	**PROCESS CONTROL FOR ATTRIBUTES**	**(09)**
Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.		
UNIT- III	**ACCEPTANCE SAMPLING**	**(09)**
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- IV	**LIFE TESTING - RELIABILITY**	**(09)**
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.		
UNIT- V	**QUALITY AND RELIABILITY**	**(09)**
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Grant, Eugene.L	*Statistical Quality Control*	*McGraw-Hill, 7th edition, 2008..*
L.S.Srinath	*Reliability Engineering*	*Affiliated East west press, 1991*

Reference Books:

1. *Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai and Sons, 2001.*
2. *R.C.Gupta, "Statistical Quality control", Khanna Publishers, 1997.*
3. *Besterfield D.H., "Quality Control", Prentice Hall, 1993.*
4. *Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.*
5. *Danny Samson, "Manufacturing and Operations Strategy", Prentice Hall, 1991*
6. *Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the basic concepts involved in manufacturing process control for variables.

CO2: describe various process control charts for attributes.

CO3: explain the concepts of acceptance sampling.

CO4: explain the life testing techniques, failure data analysis and mean failure rate.

CO5: describe Pareto analysis and product design, development and life cycle concepts.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	M	L	L									M		M
CO2	M	M	L	L									M		M
CO3	M	L	L	L									M		M
CO4	M	L	M	M									M		M
CO5	M	M	M	M									M		M
16PPEX09	M	M	M	M									M		M

L- Low, M – Moderate (Medium), H - High

16PPEX10 **ADVANCED WELDING TECHNOLOGY** Category: PE

Pre-Requisites:

L	T	P	C
3	0	0	3

1. 16PBS2Z3 – Materials Science
2. 16PPC305 – Foundry and Welding Technology
3. 16PPC306 – Engineering Metallurgy

Course Objectives:

- To impart knowledge of basic concepts, principle, procedure, applications and advances in welding processes.

UNIT- I	**SOLID STATE WELDING PROCESSES**	**(09)**
Review of the various pressure welding processes and their applications. Friction, explosive, diffusion, and Ultrasonic welding – principles of operation, process characteristics and application.		
UNIT- II	**HIGH ENERGY BEAM WELDING**	**(09)**
Electron Beam welding and Laser Welding: Principles of operation, Heat generation and regulation - Equipment details in typical setup - advantages, disadvantages and applications.		
UNIT- III	**ELECTRO SLAG WELDING**	**(09)**
Heat generation, principles of operations, wire and consumables, guide techniques, selection of current, voltage and other process variables, nature of fluxes and their selection. Electro-gas welding Principle of operation and applications, Narrow gap welding.		
UNIT- IV	**PLASMA ARC WELDING**	**(09)**
Special features of plasma arc- transferred and non transferred arc, key hole and puddle mode of operation, micro, low and high current plasma arc welding and their applications. Plasma cutting and surfacing and their applications.		
UNIT- V	**SPECIALWELDING PROCESSES**	**(09)**
Adhesive bonding and Welding of plastics, Cold pressure welding, High frequency Welding, Stud welding, Under Water welding, Welding automation.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Parmer R.S	*Welding Engineering and Technology*	*Khanna Publishers, New Delhi,2nd edition, 2010*
Parmer R.S.	*Welding Processes and Technology*	*Khanna Publishers, New Delhi, 3rd edition, 2003*
Little R.L	*Welding and welding Technology*	*Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.*

Reference Books:

1. *Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.*
2. *Tylecote R.F. "The Solid Phase Welding of Metals". New York, St. Martin's Press,1968.*
3. *AWS- Welding Hand Book. 9th Edition. Vol- 2. "Welding Process"*
4. *Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers, 2nd edition, 2005.*
5. *Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House, 1994.*
6. *Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 10th edition 1993.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe the solid state welding processes

CO2: Describe the high energy beam welding processes

CO3: Describe the Elctro-slag and Elctro-gas welding processes

CO4: Describe the plasma arc welding processes

CO5: Describe the special welding techniques for plastics and underwater welding processes

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M				M		H		L			M	M		
CO2	H		H		L		M		L	M	L		M		M
CO3	M	L	M		M		M				M	M	L		
CO4	M				L		M		L	M					
CO5	M	L	M		L		L					L			M
16PPEX10	M	L	M		L		M		L	M	L	M	M		M

L- Low, M – Moderate (Medium), H - High

16PPEX11 PRODUCT DESIGN AND PROCESS ENGINEERING Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PPC305 – Foundry and Welding Technology
2. 16PPC306 – Engineering Metallurgy
3. 16PPC405 – Metal Forming Processes
4. 16PPC406 – Machine Tools and Processes
5. 16PPC504 – Metrology and Computer Aided Inspection

Course Objectives:

- To train the students to design the product and to develop the feasible processing technique for specific need.

UNIT- I	**PRODUCT ENGINEERING**	**(09)**
Nature and scope of product engineering; creative and organizing for product innovation criteria for product success in life cycle of a product; maintainability engineering.		
UNIT- II	**MODELING AND SIMULATION**	**(09)**
Modeling and simulation; the role of models in product design mathematical modeling similitude relations; Weighted property index.		
UNIT- III	**MATERIAL SELECTION**	**(09)**
Material selection; Problems of material selection; Performance characteristics of materials; the materials selection process; economics of materials; Cost versus performance relations; Weighted property index.		
UNIT- IV	**DESIGN CONSIDERATIONS**	**(09)**
Functional and production design; form design; influence of basis design - mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminum castings, pressure die castings, plastic mounding, welded fabrications, forging and manufacture by machining methods.		
UNIT- V	**AESTHETIC AND ERGONOMIC CONSIDERATIONS**	**(09)**
Influence of space, size, weight, etc. on form design; aesthetic and ergonomic considerations; geometric dimensioning and tolerance of product; functional production and inspection datum; tolerance analysis.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
George E.DieterandLinda C. Schmidt	*Engineering design*	*McGraw HillEducation, 5th edition, 2012*
Robert Matousek	*Engineering Design*	*Blacke and Sons Ltd, 1972*

Reference Books:

1. *Jones J., "Design Methods", Wiley, 2nd edition,1992.*
2. *Buhl H.R, "Creative Engineering design", Iowa state university press, 1960.*
3. *Benjamin W.Niebel and Alan B.Draper, "Product Design and process Engineering", McGraw HillInc., US, 1st edition, 1974.*
4. *Harry peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd, 1973.*
5. *Gladman C.A., "Manual for Geometric Analysis of Engineering Designs", Australian Trade publications Ltd, 1966.*
6. *Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press, New York publications, 1967.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe the product innovation

CO2: Describe the analytical evaluation of the products

CO3: Select the appropriate material for the product

CO4: Develop the appropriate processing technique for the product

CO5: Incorporate the aesthetic and ergonomic values

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	H			H	L		H	L		M	H		
CO2	M	H	M			M	M		M				M		
CO3	L	M	M	M		M	M		M			M	M		
CO4	M		L	M		H	L		H				M		
CO5		L	L			L	M		M				L		
16PPEX11	M	M	M	M		M	M		M	L		M	M		

L- Low, M – Moderate (Medium), H - High

16PPEX12 DESIGN FOR MANUFACTURE AND ASSEMBLY Category: PE

Pre-Requisites: L T P C

1. 16PPE018 Production Management 3 0 0 3

Course Objectives:

- To acquire knowledge of the general design principles of Manufacturing.
- To familiarize various assembly methods and processes and design for assembly guidelines.

UNIT- I	**DESIGN PRINCIPLE**	**(09)**
Economics of process selection – general design principles of manufacturability – proper material selections – strength and mechanical factors – Geometric tolerances – Design for serviceability – Tolerance Charting Techniques. General aspects of the designers work - design factors – systematic working plan – basic design.		
UNIT- II	**FORM DESIGN**	**(09)**
Factors affecting casting design - Grey iron castings, steel castings, malleable iron castings – Non ferrous alloys: Aluminium castings – Pressure die castings – factors affecting weldment design – Gas and Arc welding.		
UNIT- III	**FORMED METAL COMPONENTS AND NON-METALLIC PARTS DESIGN**	**(09)**
Metal extrusion – cold headed pats – fine blanking – Tube and section bends – powder metal parts – thermo setting plastic parts – reinforced - plastic/composite parts.		
UNIT- IV	**MACHINED COMPONENTS DESIGN**	**(09)**
Design for machinability – design for economy – design for clampability – design for accessibility. Turned parts – drilled parts – milled parts, planned, shaped and slotted parts – Ground parts – parts produced by EDM.		
UNIT- V	**TECHNOLOGY REQUIREMENT AND ASSEMBLY**	**(09)**
Product design requirements for group technology concepts and CNC machining – part family concept – mechanical assemblies – general recommendations - design rules for rivets, screw fasteners, gaskets and seals. Press and snap fits.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
James G.Bralla	*Hand book of product design for manufacture*	*Mc Graw Hill Book Co., Second edition, 1999.*
Robert Matousek	*Engineering Design – A systematic approach*	*Blackie and Son Ltd, London*
Geoffrey Boothroyd, PeterDewhurst, Winston A. Knight	*Product design for manufacture and assembly*	*Taylor and Francis group, 2011.*

Reference Books:

1. *Harry Peck, Design for manufacture, Pitman publications, 1983.*
2. *Trucks H.E., Design for Economic Production, Society of Manufacturing engineers, Michigan 2nd Edition1987.*
3. *Karl T.Ulrich and Steven D Eppinger, Product Design and Development, Tata McGraw Hill, 3rd edition, 2008.*
4. *Oliver R.Wade, Tolerance Control in design and Manufacturing, Industrial Press Inc., New York Publications, 1967.*

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the basic design principles and use of tolerances in manufacturing.

CO2: describe the concepts of form design for various metals and alloys involving in casting process.

CO3: describe the design concepts of formed metals and plastic components.

CO4: explain the concepts of various machined parts design for manufacturing.

CO5: explain the assembly concepts for manufacturing and its technology requirements.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	L									L		
CO2	M	L	M	L									L		
CO3	M	L	M	L									L		
CO4	M	L	M	L									L		
CO5	M	L	M	L									L		
16PPEX12	M	L	M	L									L		

L- Low, M – Moderate (Medium), H - High

16PPEX13 HUMAN VALUES AND PROFESSIONAL ETHICS-II Category: PE

L	T	P	C
3	0	0	3

Course Objectives:

- To develop the capacity of making value judgments in real life situations and to overcome the crisis of values encountered in professional life.

UNIT - I	**HUMAN VALUES AND INTRODUCTION TO ETHICS**	**(09)**
Morals, Values and Ethics – Integrity – Work Ethic – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality - Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry.		
UNIT - II	**ETHICAL THEORIES AND PROFESSIONALISM**	**(09)**
Moral dilemmas - moral autonomy - Kohlberg's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.		
UNIT - III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**(09)**
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.		
UNIT - IV	**SAFETY,RESPONSIBILITY AND RIGHTS**	**(09)**
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.		
UNIT - V	**GLOBAL ISSUES**	**(09)**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, SAE India, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Mike Martin and Roland Schinzinger	*Ethics in Engineering*	*McGraw-Hill, New York, 3rd edition, reprint 2007*
Govindarajan M, Natarajan S, Senthil Kumar V. S	*Engineering Ethics*	*Prentice Hall of India, New Delhi, 2004*
Tripathi A N	*Human values*	*New Age international Pvt. Ltd., New Delhi, 2002*

Reference Books:

1. *Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004*
2. *Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 .*
3. *John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.*
4. *Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.*

Course Outcomes:

On completion of this course, students will be able to

CO1: recognize the basic concepts of Human values and ethics.

CO2: express the ethical theories.

CO3: identify the concept of professionalism

CO4: identify and implement the safety aspects in social experimentation

CO5: understand the impact of technical development in environmental and societal context.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	P0	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L	L	H			H	H	H	H			M	H		
CO2	L	L	H			H	H	H	H			M	H		
CO3	L	L	H			H	H	H	H	H	H	M	H		
CO4	L	L	H			H	H	H	H	H		M	H	H	
CO5	L	L	H			H	H	H	H	H		M	H	H	
16PPEX13	L	L	H			H	H	H	H			M	H		

L- Low, M – Moderate (Medium), H - High

16PPEX14 **PLANT LAYOUT AND MATERIAL HANDLING** Category: PE
(*Common to Production and Mechanical Engineering*) L T P C
3 0 0 3

Course Objectives:

- To understand basic layout and the usage of material handling equipments for industries and gain knowledge on industrial buildings and utilities

UNIT- I	**INTRODUCTION**	**(09)**
Factors to be considered for plant layout - physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements		
UNIT- II	**PLANT LAYOUT**	**(09)**
Plant layout - need for layout, factors influencing product, process, fixed and combination layout - tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models machine data. Layout planning procedure. Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.		
UNIT- III	**MATERIAL HANDLING**	**(09)**
Principles, importance and scope of material handling. Planning, operation and costing principles types of material handling systems, factors influencing their choice.		
UNIT- IV	**UTILITIES**	**(09)**
Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, ventilation and air-conditioning utilities. Planning and maintenance of waste handling statutory requirements. Packing and storage of materials - layout for packaging -packaging machinery - wrapping and packing of materials, cushion materials		
UNIT- V	**ANALYSIS OF MATERIAL HANDLING**	**(09)**
Analysis of material handling - factors involved, motion analysis, flow analysis, safety analysis, and equipment cost analysis, analysis of operation and material handling surveys.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
James, M. Apple	*Plant Layout and Material Handling*	*Kreiger Publishing Company, 1991*
Rudenko. N	*Materials handling equipment*	*Mir Publishers, 1969*

Reference Books:

1. *James, M. Moore, 'Plant Layout and Design', Macmillan Company, NY, 1963*
2. *Muther, R., 'Practical Plant Layout', McGraw Hill Book Company, NY, 1955*
3. *Colin Hardie, ,,Material Handling in Machine Shops". Machinery Publication Co. Ltd., London, 1970*
4. *Alexandrov, M., "Materials Handling Equipments", MIR Publishers, 1981.*
5. *Boltzharol, A., "Materials Handling Handbook", The Ronald Press Company, 1958.*

Course Outcomes:

On completion of this course, students will be able to

CO1: design plant layout for any type of industries.

CO2: perform effective selection and utilization of buildings and utilities.

CO3: select and utilize suitable material handling equipment.

CO4: plan appropriate HVAC system for industrial buildings.

CO5: analyze the usage of material handling equipments.

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Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	M	L	M		L	L		L	L		L		L	L	L
CO 2	M	L	M			L		L	L		L		L	M	L
CO 3	M	L	M			L		L	L		L		L	L	L
CO 4	H	L	M			L		L	L		L		L	L	L
CO 5	M	L	M		M	L		L	L		L		L	L	L
16PPEX14	M	L	M		L	L		L	L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

16PPEX15 **MANAGERIAL ECONOMICS** Category: PE

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To introduce the fundamental economic principles necessary for production managers.

UNIT- I	**FUNDAMENTALS OF MANAGERIAL ECONOMICS**	**(09)**
Goals and Constraints - The Nature and Importance of Profits - Understanding Incentives - Economic rationality, Scarcity and opportunity cost -Marginal and Incremental Analysis.		
UNIT- II	**DEMAND ANALYSIS**	**(09)**
Demand and Supply -Market Equilibrium - Price Elasticity of Demand - Price Elasticity, Total Revenue, and Marginal Revenue - Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Other Elasticities, Elasticities for Nonlinear Demand Functions - Elasticity of Supply.		
UNIT- III	**DEMAND THEORIES**	**(09)**
Choice and Utility Theory - Law of Diminishing marginal utility - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**(09)**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts - Cost Minimization and Optimal Input Substitution - The Cost Function - Breakeven analysis, Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions and Economies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**(09)**
The Nature of Industry - Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Product pricing.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Thomas and Maurice	*Managerial Economics: Concept and Applications*	*McGraw- Hill, 2005*
Maheshwari.Y	*Managerial Economics*	*Prentice Hall of India, 2012*

Reference Books:

1. D.N. Dwivedi, 'Managerial Economics' – Vikas Publishing house, 2015

2. Christopher R Thomas, S Charles Maurice, 'Managerial economics'–Mcgraw Hill, 2014

Course Outcomes:

On completion of this course, students will be able to

CO1: explain fundamentals of managerial economics.

CO2: discuss the dynamics of market forces.

CO3: explain about various theories of demand.

CO4: discuss about the cost concepts related to production.

CO5: describe about the theory of market and pricing method.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L							L	M	M	L			L
CO2	L	L	L							M	M	L			L
CO3	L									L	M	L			L
CO4	L									L	L	L			L
CO5	L	M	M	L						L	M	L			L
16PPEX15	L	L	L	L						L	M	L			L

L- Low, M – Moderate (Medium), H - High

16PPEX16 **NON DESTRUCTIVE TESTING TECHNIQUES** Category: PE

Pre-Requisites: L T P C

1. 16PPC305 - Foundry and Welding Technology 3 0 0 3

Course Objectives:

- To understand principle behind various NDT techniques.
- To study about NDT equipments and accessories.
- To learn working procedures of various NDT techniques.

UNIT- I	**INTRODUCTION**	**(09)**
NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.		
UNIT- II	**LIQUID PENETRANT & MAGNETIC INSPECTION**	**(09)**
Penetrant systems: Principles – Process - Liquid penetrant materials – Emulsifiers - cleaners developers – sensitivity - Advantages, Limitations and Applications. Magnetic methods: Advantages, Limitations - Methods of generating fields: magnetic particles and suspending liquids. Magnetography - field sensitive probes: applications. Measurement of metal properties.		
UNIT- III	**RADIOGRAPHIC METHODS**	**(09)**
Principles of radiography - sources of radiation - Ionising radiation – sources - X-rays, gamma rays Recording of radiation-Radiographic sensitivity - Fluoroscopic methods - special techniques. Radiation safety. Advantages, Limitations and Applications.		
UNIT- IV	**ULTRASONIC TESTING OF MATERIALS**	**(09)**
Ultrasonic testing: Principle - Advantages, Disadvantages, Applications - Generation of Ultrasonic waves - general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.		
UNIT- V	**ELECTRICAL AND SPECIAL METHODS**	**(09)**
Electrical methods: Eddy current methods: potential - drop methods, applications - Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Baldev Raj, T.Jayakumar, M.Thavasimuthu	*Practical Non-Destructive Testing*	*Narosa Publishing House, 2009.*
Ravi Prakash	*Non-Destructive Testing Techniques*	*New Age International Publishers, 2010*

Reference 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.*
4. *ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing,*

Course Outcomes:

On completion of this course, students will be able to

CO1: classify various non-destructive testing and choose the right method of testing for detection of defects on various materials.

CO2: check different metals and alloys by visual inspection method.

CO3: explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, Eddy current test.

CO4: describe the safety procedures of operating the NDT equipments and follow them.

CO5: detect the flow and other defects using NDT procedure for industrial component.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		M											L		M
CO2		M													M
CO3		M	M	H	M							M			
CO4						M									H
CO5			M			L									M
16PPEX16		M	M	H	M	M						M	L		M

L- Low, M – Moderate (Medium), H - High

16PPEX17 **SUPPLY CHAIN MANAGEMENT** Category: PE

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To develop the students in the dynamics of inter-organizational collaboration and coordination towards building supply chains.

UNIT- I	**INTRODUCTION TO SUPPLY CHAIN MANAGEMENT**	**(09)**
Meaning and definition of supply chain management, Difficulties of managing supply chains, the development chain, global optimization, Key issues in of supply chain management.		
UNIT- II	**INVENTORY MANAGEMENT AND RISK POOLING**	**(09)**
Introduction, single stage Inventory control, The economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.		
UNIT- III	**VALUE OF INFORMATION**	**(09)**
Introduction, Bullwhip effect-Quantifying the bullwhip effect-impact of centralized information on the bullwhip effect-supply chain with centralized demand information and decentralized demand information=managerial insights in the value of centralized information. Methods for coping with the bullwhip effect. Supply chain integration - push, pull and push-pull system. Demand driven strategies.		
UNIT- IV	**GLOBALISATION OF SCM**	**(09)**
Introduction,-Global market forces, Technological forces, global cost forces, political and economic forces. Managing global risks-speculative strategies, hedge strategies, flexible strategies- requirements for global strategy implementation. Issues in international supply chain management- International versus regional products, region-specific products, true global products. Supplies integration into to new product development- spectrum of supplier integration, keys to effective supplier integration, bookshelf of technologies and suppliers. Mass customization-Meaning, making mass customization work, mass customization and supply chain management.		
UNIT- V	**INFORMATION TECHNOLOGY FOR SCM**	**(09)**
Goals of supply chain IT, IT standards, It infrastructure, IT for supply chain excellence.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Simchi-Levi David, Kaminsky Philip, Simchi-Levi Edith and Ravi Shankar.	*Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies*	*Third Edition, Tata McGraw Hill Education Private Limited, New Delhi, Tenth reprint, 2012.*
Chopra S and Meindl P	*Supply Chain Management: Strategy, Planning and Operation*	*Second Edition, Prentice Hall India Private Limited, 2005.*

Reference Books:

1. *Robert Jacobs F, William Berry and Clay Whybark D, "Manufacturing Planning and Control for Supply Chain Management", Tata McGraw Hill, New Delhi, 2011.*
2. *Christopher, "Logistics and Supply Chain Management", Pearson Education Asia, NewDelhi*
3. *Taylor and Brunt, "Manufacturing Operations and Supply Chain Management (TheLean Approach)", Business Press Thomson Learning, NY*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the objectives of supply chain management.

CO2: describe the inventory management and risk pooling.

CO3: describe about value of information.

CO4: describe about globalization of SCM.

CO5: describe about information technology for SCM.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M					M						L		L	
CO 2	H	L			L	M			L				M	M	
CO 3									L	M		M			M
CO4	H	L				L		L					L		
CO 5		H			L				L			M		M	
16PPEX17	M	M			L	M		L	L	L		M	L	M	L

L- Low, M – Moderate (Medium), H - High

16PPEX18 **PRODUCTION MANAGEMENT** Category: PE

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To introduce various management methods in production industries.

UNIT- I	**BASICS OF MANAGEMENT**	**(09)**
Evolution of management - General principles of management – management functions – organization –types – comparison – functions of personnel management – recruitment – training – leadership - motivation – communication – conflict – Industrial relations – trade union.		
UNIT- II	**OPERATIONS MANAGEMENT**	**(09)**
Plant Location – Layout – Materials Handling – Method study – Time study – Ergonomics – Aggregate Planning – Value Analysis.		
UNIT- III	**MATERIALS MANAGEMENT**	**(09)**
Materials management - Purchasing – Objectives – parameters – procedure. Supplier selection – Stores management – codification – Waste management – Reasons for waste generation – identification and control of waste – scrap disposal.		
UNIT- IV	**INVENTORY MANAGEMENT**	**(09)**
Purpose of inventory – Cost related to inventory – Basic EOQ model – variations in EOQ model – Finite Production, quantity discounts – ABC Analysis – MRP - Introduction to MRP II and ERP.		
UNIT- V	**MARKETING MANAGEMENT**	**(09)**
Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research – market research techniques.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
R. Panneerselvam	*Production and Operations Management*	*Prentice Hall of India, 2012.*

Reference Books:

1. *Koontz and Weihrich-Essentials of Management, McGraw Hill 2015.*
2. *Philips Kotler – Marketing management, Pearson, 2015*
3. *Martand T. Telesang – Production Management – S.Chand& Co., 2007*

Course Outcomes:

On completion of this course, students will be able to

CO1: illustrate the functions of management and personnel management.

CO2: explain various ways of managing operations in engineering industries.

CO3: identify the methods for managing materials in engineering industries.

CO4: describe the importance of inventory and the ways of managing inventory.

CO5: explain the various processes involved in marketing.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L								M	M	H	M			
CO2	M	M		M	L					L	H	L	L		H
CO3	L	M	L	L	L					L	M	L			L
CO4	M	L	L	L	L					L	H	L			M
CO5		L								H	M	L			
16PPEX18	L	M	L	L	L				L	L	H	L	L		M

L- Low, M – Moderate (Medium), H - High

16PPEX19 **LEAN MANUFACTURING** Category: PE

(Common to Production and Mechanical Engineering) L T P C

3 0 0 3

Pre-Requisites:

1. 16PPC405 -Metal Forming Processes
2. 16PPC406 - Machine Tools and Processes

Course Objectives:

- To craft the students to acquire knowledge in lean manufacturing tools, understand various phases involved and methodology in implementing lean in manufacturing scenario.

UNIT- I	**ORIGIN AND FOUNDATION OF LEAN PRODUCTION**	**(09)**
Craft Production – Mass Production – Ford System – Growing Dysfunction – Origin and History of Lean Production. Necessity of Lean Production – Systems and Systems thinking – Construction of Lean Production: Lean image and Lean Activities – Muda and its types – Mura – Muri.		
UNIT- II	**STABILITY**	**(09)**
Standards in Lean System – Visual Management – 5S – Total Productive Maintenance: Key measures; Six Big Losses; Hidden Losses; Machine Loss Pyramid; Small group activity. Standardized work: Comparison of Methods Engineering and Lean thinking – Elements to be managed - Necessity and prerequisites of Standardized work – Elements of Standardized work - Charts: Production capacity chart; Standardized combination table; Standardized work analysis chart – Man power reduction – Comparison of overall efficiency with individual efficiency – Kaizen – Common Layouts.		
UNIT- III	**JUST IN TIME (JIT)**	**(09)**
Definition - Principles of JIT: Continuous Flow; Pull – JIT system – Kanban – Six Kanban rules - Expanded role of conveyance – Production leveling – Three types of Pull Systems – Value Stream Mapping: Symbols; Current state VSM and Future state VSM.		
UNIT- IV	**JIDOKA**	**(09)**
Development and necessity – Poke Yoke: Common errors – Inspection system and Zone control – Using Poke Yokes – Jidoka implementation.		
UNIT- V	**LEAN INVOLVEMENT AND CULTURE**	**(09)**
Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen Training – Lean Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Dennis P	*Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System*	*Productivity Press, New York, 2007*

Reference Books:

1. *Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India Learning Limited, New Delhi, 2012.*
2. *Gopalakrishnan N, "Simplified Lean Manufacture: Elements, Rules, Tools and Implementation", Prentice Hall of India Learning Private Limited, India, 2010.*
3. *Bill Carreira, "Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits", Prentice Hall of India Learning Private Limited, India, 2007.*
4. *Don Tapping, Tom Luyster and Tom Shuker, "Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements", Productivity Press, New York, USA, 2002.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe about the origin and foundation of lean production.

CO2: Describe about stability and standards in lean system.

CO3: Describe about Just In Time (JIT) and its application in lean.

CO4: Describe about Jidoka and Poke Yoke.

CO5: Describe about lean involvement and culture.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L		M		L	H	M				L	L		L	
CO2	M	L		M	L	M	L		L			M	M	M	
CO3			H	L					L	M				L	M
CO4	H	L		M		M		L				M	L	H	
CO5		M	H		L		L		L						
16PPEX19	M	L	M	M	L	M	L	L	L	M	L	M	L	M	L

L- Low, M – Moderate (Medium), H - High

16PPEX20 **MICRO MANUFACTURING PROCESSES** Category: PE

Pre-Requisites: L T P C

1. 16PPC305 – Foundry and Welding Technology 3 0 0 3
2. 16PPC405 - Metal Forming Processes
3. 16PPC406 - Machine Tools and Processes

Course Objectives:

- To be familiar with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

UNIT- I	**MICRO MACHINING I**	**(09)**
Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.		
UNIT- II	**MICRO MACHINING II**	**(09)**
Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Electro Discharge Grinding – Electro Chemical spark micro machining.		
UNIT- III	**NANO POLISHING**	**(09)**
Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo-mechanical Polishing.		
UNIT- IV	**MICRO FORMING AND WELDING**	**(09)**
Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.		
UNIT- V	**RECENT TRENDS AND APPLICATIONS**	**(09)**
Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Jain V. K.	*Micro Manufacturing Processes*	*CRC Press, Taylor & Francis Group, 2012*

Reference Books:

1. Jain V.K., Introduction to Micro machining' Narosa Publishing House, 2011

2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.

3. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002

4. Mcgeough.J.A., Micromachining of Engineering Materials, CRC press 2001.

5. http://www.cmxr.com/Education/Introduction.html

Course Outcomes:

On completion of this course, students will be able to

CO1: describe various mechanical micro machining processes

CO2: describe various beam energy based micro machining processes.

CO3: explain various methods of nano polishing techniques.

CO4: understand and explain the micro forming and welding processes.

CO5: use the knowledge of micro manufacturing processes into engineering applications.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M				H			M	L	M		M	M		
CO2	M				H			M	M	M		M	M		
CO3	M				H				M	M		M	M		
CO4					M				L	M		M	M		
CO5	H				H	M		M	M	M			M		
16PPEX20	M				H	M		M	M	M		M	M		

L- Low, M – Moderate (Medium), H - High

16PPEX21 **THEORY OF METAL CUTTING** Category: PE

(Use of approved data book is permitted)

(Common to Production and Mechanical Engineering)

L	T	P	C
3	0	0	3

Pre-Requisites:

1. 16PES206 -Engineering Mechanics
2. 16PES304 -Thermal Sciences
3. 16PBS3Z1 -Engineering Mathematics III

Course Objectives:

- To familiarize students about the basic mechanics, thermal, wear and chatter mechanisms in metal cutting processes.

UNIT- I	**ORTHOGONAL CUTTING**	**(09)**
Basic mechanism of chip formation –Techniques for study of chip formation, types of chips - Chip breaker - Orthogonal Vs Oblique cutting – Shear plane angle - Cutting force and velocity relationship in orthogonal cutting - Modern theories in Mechanics of cutting - Review of Merchant and Lee Shaffer Theories.		
UNIT- II	**OBLIQUE CUTTING**	**(09)**
Direction of Chip flow - Normal Velocity and Effective Rake angles - Relationship between rake angles - Cutting ratios in oblique cutting - Shear angle and Velocity relationship - Stabler's rule		
UNIT- III	**THERMAL ASPECTS OF MACHINING**	**(09)**
Heat distributions in machining - Experimental determination and Analytical calculation of cutting tool temperature -Heat in primary shear Zone, Heat in Tool / Work Interface, Heat in Areas of Sliding - effects of various parameters on temperature -Cutting fluids - Effects of cutting fluid - Functions - Requirements - Types and Selection of Cutting Fluids.		
UNIT- IV	**CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR**	**(09)**
Essential requirements of tool materials - Structure and properties of High speed steel and Cemented carbides - development in tool materials - ISO specification for inserts and tool holders - tool life - conventional and accelerated tool life tests - concept of machinability index - economics of machining - Reasons for failure of cutting tools and forms of wear-mechanisms of wear		
UNIT- V	**DESIGN OF CUTTING TOOLS**	**(09)**
Nomenclature of Single point and Multi point cutting tools - Design of Turning tool, Drills, Milling cutters and tool holders.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Boothroid D.G. & Knight W.A.	*Fundamentals of machining and machine tools*	*Marcel Dekker, Newyork, 1989*

Reference Books:

1. *Shaw.M.C. Metal cutting principles, oxford Clare don press, 1984.*
2. *Bhattacharya.A. Metal Cutting Theory and practice, Central Book Publishers, India, 1984.*

Course Outcomes:

On completion of this course, students will be able to

CO1: elaborate the mechanisms of chip formation in different types of metal cutting processes.

CO2: predict the magnitude of cutting forces for a tool at the given operating conditions.

CO3: realize the thermal effect of cutting process in and around the cutting region.

CO4: predict the effect of cutting parameters on life of different cutting tools.

CO5: design a cutting tool for metal cutting process.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	L	M	L		M	L		L		L		L	M	L
CO2	H	H	H	H		M	L		L		L		M	M	L
CO3	H	H	H	H		M	L		L		L		M	M	L
CO4	H	H	H	H		M	L		L		L		M	M	L
CO5	H	H	H	L		H	L		L		L		H	M	L
16PPEX21	H	H	H	M		M	L		L		L		M	M	L

L- Low, M – Moderate (Medium), H - High

16PPEX22 **ADVANCED CASTING TECHNOLOGY** Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To impart knowledge on various advanced casting techniques.

UNIT- I	**CASTING OF METALS**	**(09)**
Factors influencing casting of cast iron, steel, aluminium, magnesium, copper - factors influencing the casting practice - casting quality control. X-ray, sand control method - control of casting and casting defects.		
UNIT- II	**ROBOTICS IN METAL CASTING**	**(09)**
Structure and classification of Industrial Robots, Terminology of robot motion, Die cast Robots and Foundry Robots- advantages , applications. Robotic automation in permanent mold foundries.		
UNIT- III	**ADVANCES IN METAL CASTING**	**(09)**
Hcasting, shell moulding, investment casting, foam casting, centrifugal casting, Die casting, continuous casting,squeeze casting - processes and parameters.		
UNIT- IV	**CASTING METALLURGY**	**(09)**
Solidification of pure metals, alloys, dendritic growth, homogeneous and heterogeneous nucleation, constitutional under cooling, defects in casting causes and remedies. Long range and short range solidifying alloys.		
UNIT- V	**COMPUTER AIDED METAL CASTING**	**(09)**
Use of computer in runner and riser design, solidification front monitoring, expert system in casting defects, software mine-spectroscopy and chemical analysis.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Jain P.L	*Principles of Foundry Technology*	*Tata McGraw-Hill Publishers, 4th edition 2008.*
Heineloper& Rosenthal	*Principles of Metal Casting*	*Tata McGraw Hill Publishers,2nd edition, 2000.*

Reference Books:

1. ASM Handbook, Vol 15, Casting, 2004

2. Jain R.K. and Gupta S.C., "Production Technology", Khanna Publishers, New Delhi, 17th edition, 2004.

3. Rao, P. N., Manufacturing Technology, McGraw Hill Publishers , 3rd edition ,2010.

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the factors influencing casting of metals.

CO2: explain the robots in metal casting.

CO3: explain various advanced casting processes.

CO4: describe the thermal, metallurgical aspects during solidification in casting.

CO 5: explain the applications of computer in metal casting.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M		L		L	L	L	L	L		L	H		L
CO2	L	M	H			M	M	L	L	L		L	H		L
CO3	M	M	L	L	L	M	L	L	L	L		L	H		L
CO4	L	H	M	L	L	M	L			L		L	H		L
CO5	L	M	M	M	M	L	L	L	L	L		L	H		L
16PPEX22	L	M	M	L	L	M	L	L	L	L		L	H		L

L – Low, M- Moderate (Medium), H - High

16PPEX23 **TOTAL PRODUCTIVE MAINTENANCE** Category: PE

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To enable the students to understand basic concepts of Total Productive Maintenance.
- Expose the students to the objectives, maintenance models, group activities, logistics, condition monitoring and implementation of Total Productive Maintenance.

UNIT- I	**MAINTENANCE CONCEPTS**	**(09)**
Introduction - Objectives and functions – Productivity, Quality, Reliability and Maintainability (PQRM) - Terotechnology - Reliability Centered Maintenance - Predictive Maintenance - Condition Based Maintenance - maintainability prediction - availability and system effectiveness- maintenance costs - maintenance organization.		
UNIT- II	**MAINTENANCE MODELS**	**(09)**
Minimal repair - As Good As New policy - maintenance types - balancing Preventive Maintenance and breakdown maintenance – Preventive Maintenance schedules: deviations on both sides of target values - PM schedules: functional characteristics - replacement models.		
UNIT- III	**FUNDAMENTALS OF TPM**	**(09)**
Zero breakdowns - Zero Defects and TPM - maximizing equipment effectiveness – Autonomous maintenance program - five pillars of TPM - TPM small group activities - TPM organization - Management Decision - Educational campaign - Creation of Organizations - Establishment of basic policies and goals - Formation of master plan - TPM implementation.		
UNIT- IV	**MAINTENANCE LOGISTICS**	**(09)**
Human factors in maintenance - maintenance manuals - maintenance staffing methods - queuing applications - simulation - spare parts management - maintenance planning and scheduling.		
UNIT- V	**ONLINE MONITORING**	**(09)**
Condition monitoring - Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks - corrosion control - Maintenance Management Information System - Expert system applications.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Nakajima S.	*Introduction to TPM*	*Productivity Press, Chennai, 1992*
Srivastava S.K.	*Maintenance Engineering (Pri.Practices& Management)*	*S. Chand Group, 2011*

Reference Books:

1. Wireman T., "Total Productive Maintenance", Industrial Press Inc., New york, 2004.

2. Goto F., "Equipment planning for TPM Maintenance Prevention Design", Productivity Press,1992

3. Shirose K., "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.

4. Shirose K., "TPM for Operators", Productivity Press, 1996.

5. Suzuki T., "New Directions for TPM", Productivity Press, 1993.

6. Kelly A., "Maintenance planning and control", Butterworths, London, 1991.

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the concept of total productive maintenance used in the industries.

CO2: describe how TPM improves operations by preventing equipment breakdowns and prevention of product defects and rejects.

CO3: understand the usage of tools for TPM implementation and able to identify and eliminate loss through TPM implementation.

CO4: describe the logistics involved in Total productive Maintenance..

CO5: effectively use the total productive maintenance for online monitoring of processes.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1								M	M	H		M			
CO2	M	H				M		M	M	M	M	M			L
CO3	L				M			M	M	M		M	M		M
CO4								M	M			H			
CO5					L			M	M			M			L
16PPEX23	L	L			L	M		M	M	M	M	M	M		L

L- Low, M – Moderate (Medium), H – High

16PPEX24 **GREEN MANUFACTURING** Category: PE

Pre-Requisites: L T P C

1. 16PHS2Z4 – Environmental Science and Engineering 3 0 0 3

Course Objectives:

- To introduce the basic concepts needed to proceed green manufacturing

UNIT- I	**OUR ENVIRONMENT**	**(09)**
The human population and the environment, the human population's effects on the earth, the ecosystem, chemical cycling and succession, the biogeochemical cycles, major global biogeochemical cycles - carbon, carbon-silicate, nitrogen and phosphorus cycles, global warming, greenhouse effect, major greenhouse gases.		
UNIT- II	**MANUFACTURING SYSTEMS**	**(09)**
Levels of manufacturing systems, environmentally conscious manufacturing- components, system effects and assessment		
UNIT- III	**WATER POLLUTION IN MANUFACTURING SYSTEMS**	**(09)**
Metalworking fluids- environmental and health impact, Heavy metals in water, MWF pollution prevention through process planning, process modification and in process recycling, water footprint analysis.		
UNIT- IV	**AIR AND SOLID POLLUTION IN MANUFACTURING SYSTEMS**	**(09)**
Origin of airborne particles in manufacturing, traditional and modern particulates mitigation/elimination techniques. Industrial solid and hazardous waste management, Carbon footprint analysis.		
UNIT- V	**ENVIRONMENTAL MANAGEMENT SYSTEMS**	**(09)**
Eco-labeling - Design for the Environment, Concepts of ISO 14001 - requirements of ISO 14001 – Environmental Management System – frame work and benefits.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Daniel B Botkin and Edward A Keller	*Environmental Science*	*John Wiley & Sons, Chichester, 2010*
Madu. C.N	*Handbook of Environmentally Conscious Manufacturing*	*Kluwer Academic Publisher, 2001.*

Reference Books:

1. Swamidass, P.M., "Encyclopedia of Production and Manufacturing Management", Kluwer Academic Publisher, 2000.

2. Kutz, M., "Environmentally Conscious Mechanical Design", John Wiley & Sons, 2007.

3. Davim, J.P., "Sustainable Manufacturing", John Wiley & Sons, 2010.Koontz and Odonnel-Essentials of Management, McGraw Hill 1992.

Course Outcomes:

On completion of this course, students will be able to

CO1: explain about the effect of humans on ecosystems and various phenomenon of ecosystems.

CO2: explain about the environmentally conscious manufacturing systems.

CO3: Evaluate the effects of water pollution by manufacturing systems and their prevention.

CO4: discuss the effects of air and solid pollution in manufacturing systems.

CO5: explain about environmental management systems.

Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L					H	H	M	L	M	L	H			L
CO2	L	L	M	L		H	H	M	L	M	L	H			L
CO3	L	L	L	L		H	H	M	L	M	L	H			L
CO4	L	L	M	L		H	H	M	L	M	L	H			L
CO5	L	M	M	L		H	H	M	L	M	L	H			L
16PPEX24	L	L	M	L		H	H	M	L	M	L	H			L

L- Low, M – Moderate (Medium), H - High

16AOEX01 **NANOSCIENCE AND TECHNOLOGY** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of nano systems
- To be familiar with various methods of synthesis of nano materials
- To analyze and understand the mechanical and electrical properties of nonmaterial and its applications
- To realize the importance of Nonporous materials and its applications
- To make the students to understand the fundamental aspects of properties leading to technology

UNIT- I	**NANO SYSTEMS**	**(9 Periods)**
Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Top down and Bottom up approach.		
UNIT- II	**SYNTHESIS OF NANOMATERIALS**	**(9 Periods)**
Sol-Gel Process - Self assembly – Electrode position - Spray Pyrolysis - Flame Pyrolysis – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Orgonic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process.		
UNIT- III	**PARTIAL DIFFERENTIAL EQUATIONS**	**(9 Periods)**
Nanoscale Mechanics - Introduction – Mechanical properties – Density Considered as an Example Property – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials - The Physical Basis of Yield Strength – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity. Introduction - Energy Storage Basics - General Information: Electrical Energy Storage Devices and Impact of Nanomaterials – Batteries – Capacitors - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls		
UNIT- IV	**NANOPOROUS MATERIALS**	**(9 Periods)**
Nanoporous Materials – Silicon - Zeolites, mesoporous materials – nano membranes and carbon nanotubes - AgX photography, smart sunglasses and transparent conducting oxides- Hydrophobic & Hydrophilic materials – molecular sieves – nanosponges.		
UNIT- V	**NANOTECHNOLOGY APPLICATIONS**	**(9 Periods)**
Applications of nanoparticles, quantum dots, Nanotubes and nanowires for nanodevice fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – principle of Dip Pen Lithography.		

Contact Periods:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Reference books:

1. *G. Timp. Editor, "Nanotechnology" AIP press, Springer-Verlag, New York, 1999*
2. *Hari Singh Nalwa, Editor, "Nanostructured materials and Nanotechnology", Concise Edition, Academic Press, USA (2002).*
3. *Guozhong Gao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press (2004).*
4. *K. T. Ramesh, "Nanomaterials : Mechanics and Mechanisms", Springer 2009.*
5. *Kenneth J. Klabunde, "Nanoscale materials in chemistry", John Wiley & Sons, 2001.*
6. *Hari Singh Nalwa, Editor, "Hand book of Nanostructured Materials and Technology", Vol.1-5, Academic Press, USA (2000).*
7. *"Hand book of Nanoscience, Engineering and Technology" (The Electrical Engineering handbook series), Kluwer Publishers, 2002*
8. *N John Dinardo, Weinheim,"Nanoscale characterization of surfaces & interfaces", Cambridge: Wiley-VCH, 2nd ed., 2000*
9. *G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.*
10. *J.George, "Preparation of Thin Films", Marcel Dekker, Inc., New York. 2005.*

Course Outcomes:

CO1: Analyze the particle size, particle shape, particle density, Size effect and properties of nanostructures. **[Familiarity]**

CO2: Acquire knowledge in various methods of synthesis of Nano materials. **[Application]**

CO3: Analyze the Elasticity of Nanomaterials, Electrical Energy Storage Devices and Aerogels. **[Assessment]**

CO4: Acquire knowledge in Zeolites, mesoporous materials, nano membranes and carbon nanotubes. **[Familiarity]**

CO5: Apply various nano materials to the LED, Transistor Applications. **[Usage and Assessment]**

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		H		M		L									
CO2	M			L	H										
CO3		H			L		M								
CO4	H			M		L									
CO5	L		H				M					M			
16AOEX01	L	L	L	L	L	L	L					L			

L- Low, M – Moderate (Medium), H - High

16AOEX02 **MATERIAL CHARACTERIZATIONS** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To Understand and analyze the concepts of Thermo gravimetric analysis, Differential thermal analysis.
- To be familiar with various methods of microscope.
- To analyze and understand the working principle of SEM, FESEM, EDAX and HRTEM.
- To realize the importance of Electrical methods and its limitations.
- To understand the fundamental aspects and properties of spectroscopy techniques.

UNIT- I	**THERMAL ANALYSIS**	**(9 Periods)**
Introduction – thermo gravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves - differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermo mechanical parameters .		
UNIT- II	**MICROSCOPIC METHODS**	**(9 Periods)**
Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy - phase contrast microscopy - fluorescence microscopy - confocal microscopy - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.		
UNIT- III	**ELECTRON MICROSCOPY AND OPTICAL CHARACTERISATION**	**(9 Periods)**
SEM- FESEM- EDAX,- HRTEM: working principle and Instrumentation – sample preparation – Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.		
UNIT- IV	**ELECTRICAL METHODS**	**(9 Periods)**
Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V, I-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations.		
UNIT- V	**SPECTROSCOPY**	**(9 Periods)**
Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, ESCA and SIMS- proton induced X-ray Emission spectroscopy (PIXE) – application – mass spectroscopy.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Reference books:

1. *Stradling, R.A; Klipstain, P.C; "Growth and Characterization of semiconductors", Adam Hilger, Bristol,1990.*
2. *Belk, J.A; "Electron microscopy and microanalysis of crystalline materials", Applied Science Publishers, London, 1979.*
3. *Lawrence E.Murr, "Electron and Ion microscopy and Microanalysis principles and Applications", Marcel Dekker Inc., New York, 1991*
4. *D.Kealey & P.J.Haines, "Analytical Chemistry", Viva Books Private Limited, New Delhi, 2002.*
5. *G. Gao, "Nanostructures and Nanomaterials", Imperial College Press, London, 2006*
6. *Y. Gogotsi, "Nanomaterials Handbook", CRC Taylor and Francis, New York, 2006*
7. *Banwell, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill, 1994*.

Course Outcomes:

CO1: Analyze the properties of TGA, DTA and DSC. [Assessment]

CO2: Acquire knowledge in various types of microscopes. [Familiarity]

CO3: Analyze the working principle and Instrumentation of SEM, FESEM, EDAX, and HRTEM [Familiarity]

CO4: Acquire knowledge in I-V and C-V characteristics. [Application]

CO5: Analyze the Principles and instrumentation of Spectroscopy methods. [Familiarity]

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		H			M	M	L								
CO2	H	M	M				L					L			
CO3		H	M	M	L										
CO4	M	H		L	M										
CO5		M	H		L	M						L			
16AOEX02	L	H	L	L	L	L	L					L			

L- Low, M – Moderate (Medium), H - High

16AOEX03 **ELECTROCHEMICAL TECHNOLOGY** Category: OE

(Common to All Branches)

Pre-Requisites: Nil

L	T	P	C
3	0	0	3

Course Objectives:

- This course aims at making Mechanical Engineers know about Electrochemical principles applied in manufacturing of Chemical products, fabrication of metals, metallurgy and corrosion studies.

UNIT- I		**(09)**
Fundamental concepts, electron transfer, mass transfer, adsorption, electro-catalysis, phase formation in electrode reaction, assessment of cell voltage, costing of electrolytic process, performance and figure of merit. Typical cell designs. Laboratory data and scale-up.		
UNIT- II		**(09)**
Chlor-alkali industry-concept of brine electrolysis, chlorine cell technology, the production of NaOH. Water electrolysis, sodium chlorate, hydrogen peroxide, ozone, cuprous oxide, and synthesis of metal salt via anodic dissolution, Organic electro synthesis-dimerization of acrylonitrile, indirect electro synthesis.		
UNIT- III		**(09)**
The extraction, refining and production of metal–electro-winning, cementation, electro-refining, Electro-deposition of metal powders. Corrosion and its control-thermodynamics and kinetics of corrosion reactions, corrosion problems in practice, corrosion prevention and control, corrosion problems in electrolytic processing, corrosion measurement and monitoring.		
UNIT- IV		**(09)**
Metal finishing-electroplating, electroless plating, conversion coatings, electroforming, electrochemical etching. Batteries and fuel cells-battery characteristics, battery specifications, evaluation of battery performance, battery components. Fuel cells.		
UNIT- V		**(09)**
Water purification, effluent treatment and recycling of industrial process stream- metal ion removal and recovery, treatment of liquors containing dissolved chromium, electrolytic method of phase separation, flue gas desulphurization, electrodialysis. Electrochemical sensor and monitoring techniques, polarographic to anodic stripping voltammetry, ion selective electrode, electrochemical biosensors.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Derek Pletcher and Frank C Walsh	*Industrial Electrochemistry*	*2nd edition, Chapman & Hall, UK, 1990*
A.T.Kuhn,	*Industrial Electrochemistry*	*Elsevier Publishers, 1972*

Reference books:

1. C.L. Mantell, "Chemical Engineering Series – Industrial Electrochemistry", McGraw Hill Co., Inc. London, 1958.

2. Ullmann's "Encyclopedia of Industrial Chemistry", John Wiley & Sons, Vol.6, pp: 399 - 481, 2003.

3. Krik–"Othmer Encyclopedia of Chemical Technology", 4th edition, Vol: I., Pp938 –1025 (1991).

4. N.M.Proutand J.S.Moorhouse, "Modern Chlo-Alkali Technology", Vol. IV, Elsevier Applied Science, London, 1990.

Course Outcomes:

Students after the completion of this course:

CO1: Students will be able to understand the electrodic processes and design cell requirements

CO2: Students can apply the electrolysis principle in manufacture of materials required for regular use.

CO3: Students will be able to apply their technical skill in metallurgy.

CO4: Students will be able to acquire knowledge in all metal finishing techniques.

CO5: Students will gain knowledge in solving the problems of corrosion of equipment and battery systems.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	H	M	M	H	L									
CO2	L	M	H	L	H	L									
CO3	H	L	H	M	M	H									
CO4	M	L	L	L	M	H									
CO5	L	M	H	L	H	M									
16AOEX03	M	M	M	L	H	M									

L- Low, M – Moderate (Medium), H - High

16AOEX04 **POLYMER TECHNOLOGY** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- This course is aimed to make Mechanical Engineers apply their skills in identifying the types of polymers and their properties applicable to plastics and rubber processing.

UNIT- I	**CHEMISTRY OF HIGH POLYMERS**	**(09)**
Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; metallocene polymers and other newer techniques of polymerization, copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension and emulsion.		
UNIT- II	**SYNTHESIS AND PROPERTIES**	**(09)**
Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, ABS, Fluoropolymers - Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE.		
UNIT- III	**POLYMER TECHNOLOGY**	**(09)**
Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, cross-linking and vulcanization, Compression molding, transfer molding, injection molding, blow molding, reaction, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.		
UNIT- IV	**POLYMER BLENDS AND COMPOSITES**	**(09)**
Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, FRP, particulate, long and short fibre reinforced composites.		
UNIT- V	**POLYMER TESTING**	**(09)**
Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Reference Books:

1. F.W. Billmeyer, Jr., "Textbook of polymer science", Wiley - Interscience, N.Y.(1971)

2. G.Odian , "Principles of polymerization", Wiley – Interscience (1981)

3. Gowarikar V.R. and others , "Polymer science", Wiley Eastern (1986).

4. Fenner R.T., "Principles of polymer processing", Chemical publishing N.Y. (1979)

Course Outcomes:

Students after the completion of this course:

CO1: Will be able to identify different types of polymers by structure and behaviour, properties and their method of polymerisation.

CO2: Will be able to apply various processes of fabrication of plastics and rubber.

CO3: Will be able to distinguish polymer blends and composites and understand their specific applications.

CO4: Will be able to test the polymer specimens for mechanical properties applicable for various end uses.

CO5: Will be able to test the polymer specimens for electrical properties applicable for various end uses.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	H	L	L	M	H									
CO2	L	L	H	M	H	L									
CO3	M	M	L	L	M	L									
CO4	L	L	M	M	M	H									
CO5		H	L	L	H	M									
16AOE X04	L	M	M	L	M	M									

L- Low, M – Moderate (Medium), H - High

16COEX05 **DISASTER MANAGEMENT AND MITIGATION** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To give knowledge about basics of Disaster Management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about Response and Recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT- I	**INTRODUCTION**	**(08)**
Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.		
UNIT- II	**HAZARDS AND RISK VULNERABILITY**	**(10)**
Hazard Identification and Hazard Profiling, hazard analysis, Types of hazards- Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – purpose, Risk Acceptability, Alternatives, Personnel. Political/social, Economic. Vulnerability - Physical Profile, Social Profile, Environmental Profile, Economic Profile. Factors Influencing Vulnerability, risk Perception.		
UNIT- III	**MITIGATION AND PREPAREDNESS**	**(08)**
Mitigation - types of mitigation, Obstacles in mitigation, Assessment and selection of Mitigation options, Emergency response capacity as, Incorporating Mitigation into development and relief projects Prepareness- Government Preparedness, Public Preparedness, Media as a public educator. Obstacles to public education and preparedness.		
UNIT- IV	**RESPONSE AND RECOVERY**	**(09)**
Response the Emergency- Pre disaster, post disaster, Provision of water, food and shelter, volunteer management , command , control and coordination Recovery- short term and long term recovery .components of recovery- planning, coordination, information, money and supplies, allocation of relief funds, personnel. Types of recovery- Government, Infrastructure, Debris removal disposal and processing, environment, housing, economic and livelihood, individual, family and social recovery- special considerations in recovery.		
UNIT- V	**PARTICIPANTS**	**(10)**
Governmental Disaster management agencies- Fire, law, emergency management, Emergency medical service, Military and other resources. Structures- local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Non Governmental Organisations – operations, NGO/ Military coordination, standard of conduct. The role of Private sector and academia. Multilateral organisations - UN agencies and progammes, Regional &International organisations. International Financial Institutions- the world bank, IMF, ADB, IADB. Special considerations.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Damon P. Coppola	*Introduction to International Disaster management*	*Elsevier publication, 2015*

Reference Books:

1. Brassard, Caroline, Giles, David W., Howitt, Arnold M., "Natural Disaster Management in the Asia-Pacific", Policy and Governance.
2. "Disaster Management", Global Challenges and Local Solutions, Universities Press, 2009.
3. Jack Pinkowski, "Disaster Management Handbook", CRC Press,January 22, 2008.
4. Disaster Management Guidelines, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

Course Outcomes:

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

CO1: Able to get knowledge about basics of Disaster management.

CO2: Able to impact knowledge about Hazards and vulnerability

CO3: Able to know about Mitigation and preparedness.

CO4: Able to attain knowledge about response and recovery.

CO5: Able to learn about the participants involved in the disaster management activity.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1		L			L	L		L							
CO2	L	H		M	L	M						L			
CO3	L	L			H	M						L			
CO4	L	M		L	L	M	M								
CO5		M		L	L	M									
16COEX05	L	M		L	L	M	L					L			

L- Low, M – Moderate (Medium), H - High

16COEX06 **ENVIRONMENTAL MANAGEMENT** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites:

16PHS2Z4 Environmental Science and Engineering

Course Objectives:

- To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.

UNIT- I	**NATURE AND SCOPE OF ENVIRONMENTAL PROBLEMS**	**(09)**
Environment and sustainable development – Natural and human environmental disturbances – Global warming –acid rain – ozone depletion – effects and control - climate change conventions – Kyoto protocol – India's efforts for Environmental protection – Public policy and role of NGO's.		
UNIT- II	**WATER POLLUTION AND CONTROL**	**(09)**
Fresh water and its pollution – Natural processes – sources and pollutants – pollution due to industrial, agricultural and municipal wastes – effects on streams - limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management – Marine environment and its management – Water acts.		
UNIT- III	**AIR AND NOISE POLLUTION**	**(09)**
Pollutant emissions - sources and sink – effects of air pollution on human health, vegetation and climate– Global effects – prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution – Sound level – Effect of noise on people – Environmental noise control- noise pollution rules, 2000		
UNIT- IV	**SOLID WASTE MANAGEMENT AND SOIL POLLUTION**	**(09)**
Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques – Onsite Handling, storage and processing – sanitary landfill – Incineration and pyrolysis – Composting – aerobic and anaerobic of compositing – Recycling and reuse of solid wastes – Hazardous wastes – Definition – Sources & types only – Integrated system for waste management – The Basel convention Land use and degradation – Management problems – strategies for sustainable land management – soil pollution –wetland conservation.		
UNIT- V	**ENVIRONMENTAL MANAGEMENT SYSTEM**	**(09)**
Terminology – installation and common motives of EMS – Environmental standards – ISO 14000 (Series) – basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection– Practices for Waste Minimisation and Cleaner Production.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
N.K.Uberoi	*Environmental Management*	*Excel Books, New Delhi (2006).*
Rao	*Air Pollution*	*Tata Mc Graw-Hill Education, 01-Jun-1988*

Reference Books:

1. S.Vigneahwaran,M.Sundaravadivel and D.S.Chaudhary "Environmental Management", SCITECH Publications (India) Pvt. Ltd, Chennai & Hyderabad (2004).

2. Technobanoglous, "Environmental Management", McGraw Hill Book Company (2006).

Course Outcomes:

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

CO1: Students exposed to know common issues related with environment.

CO2: Students able to know the sources, causes and effects of water pollution.

CO3: Able to attain knowledge related with air and noise pollution.

CO4: Able to understand the various management techniques of solid waste and soil Pollution.

CO5: Able to aquire knowledge on Environmental Management Systems.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	L					M								
CO2	L	M			L		H					L			
CO3	L	M			L		H					L			
CO4	L	M			L		H					L			
CO5	M	L					M								
16COEX06	L	M			L		H					L			

L- Low, M – Moderate (Medium), H - High

16COEX07 **TOWN PLANNING AND ARCHITECTURE** Category: OE

(Common to All Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- Students are introduced the basics of Town Planning and Architecture.

UNIT- I	**TOWN PLANNING**	**(09)**
History of evolution of towns - Town and environment – Planning acts – land use classification – Transportation network - Climate, humidity, wind and radiation - Surveys and Data collection - Residential neighborhoods - Industrial areas - Public Buildings - Housing and Slum clearance.		
UNIT- II	**BUILDING RULES AND GUIDELINES**	**(09)**
General – Zoning regulations – Regulations regarding layouts or subdivisions – Building regulations – Rules for special types of buildings – Floor space index – minimum plot size and building front age – Open spaces – Minimum standard dimensions of building elements – Provision for lighting and ventilation – Provision for means of access – Provision for urban growth.		
UNIT- III	**BASIC ELEMENTS OF ARCHITECTURE**	**(09)**
Introduction of Architecture – Definition – Mass and space visual emotional effects of geometric forms and their derivatives– The sphere, the cube, the pyramid, the cylinder and cone – The aesthetic qualities of Architecture – Proportion, scale, balance, symmetry, rhythm and axis – contrast in form – Harmony – Consideration of comfort factors acoustics, lighting, ventilation and thermal aspects.		
UNIT- IV	**PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS**	**(09)**
General – factors affecting orientation – sun – Wind – Rain – Orientation criteria for Indian conditions – Principles governing the theory of Planning – General requirements of site and building – Functional planning of buildings.		
UNIT- V	**ELEMENTS OF INTERIOR DESIGN**	**(09)**
General – Decorative Materials – Cement Bonded Board (BISON PANEL), Water proof cement paint, Industrial glazing and Roofing, unit masonry, plaster and dry wall, Wall surface materials, Effect of colour on architecture – Home furnishing– plans in rooms.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
S.C.Rangwala	*Elements of Town Planning*	*McGraw Hill, London, 2006.*
Biswas Hiranmay	*Principles of Town Planning and Architecture*	*VAYU Education of India, 2012*

Reference Books:

1. V.S.Pramar, "Design fundamentals and architecture" Lakshmi Publishers, 2003.
2. Hiraskar, "Fundamentals in town planning" Khanna Publishers, 2005.

Course Outcomes:

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

CO1: Students will be able to know about the basics of town planning and building rules.
CO2: Students will be able to gain knowledge on building rules & regulations.
CO3: Students able to apply the architectural principles in the area of Civil Engineering.
CO4: Students will be able to do planning of various buildings.
CO5: Students will be able to understand about interior design of buildings.

Course Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1				M								L			
CO2							M				L	L			
CO3		L		L						M					
CO4		L		L						M					
CO5		M						L				H			
16COEX07		L		L			M	L		M	L	L			

L- Low, M – Moderate (Medium), H - High

16MOEX09 **COMPOSITE MATERIALS** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites:

16PBS2Z3 Material Science

Course Objectives:

- To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

UNIT- I	**INTRODUCTION TO COMPOSITE MATERIALS**	**(09)**
Types and characteristics of composite materials - Mechanical behavior - Basic terminology and Manufacture of laminated fiber - Reinforced composite materials - Current and potential advantages - Applications of composite materials.		
UNIT- II	**REINFORCEMENT AND MATRICES**	**(09)**
Different types of fibers - Properties and applications of fibers - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix -Thermoplastic matrix, Fiber architecture – Natural Fibers.		
UNIT- III	**DESIGN OF COMPOSITE STRUCTURES**	**(09)**
Elements of Design - Steps in design process - Elements of analysis in design - Analysis iterations - Design analysis stages - Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.		
UNIT- IV	**MANUFACTURING OF ADVANCED COMPOSITES**	**(09)**
Bag-Molding process-Compression molding-Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.		
UNIT- V	**METAL, CERAMIC AND CARBON MATRIX COMPOSITES**	**(09)**
Metal matrix composites - Manufacturing processes - Ceramic matrix composites- Mechanical properties - Manufacturing processes - Carbon matrix composites - Fabrication methods - Applications.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Krishnan K., Chawla	*Composite Materials Science and Engineering*	*Springer(India) Private Limited, 2011.*
P.K. Mallick	*Fiber Reinforced Composite materials, Manufacturing and Design*	*CRC Press, Taylor and Francis Group, Boca Raton, London, Newyork 2010.*

Reference Books:

1. A.K.Bhargava, "Engineering Materials: Polymers, ceramics and composites", Pentice Hall of India Limited, 2010.

2. Hyer M., Stress Analysis of Fiber – "Reinforced Composite Materials", Tata McGraw Hill, 1998.

3. Madhujit Mukhopadhyay , "Mechanics of Composite Materials and Structures ", Universities Press (India) Private Limited, 2009.

4. Robert M.Jones, "Mechanics of Composite Materials", Taylor & Francis Group, 2010.

5. Web Portal: Composite Materials {Nptel .Mechanical Engineering}

Course Outcomes:

On completion of this course, students will be able to

CO1: understand the mechanics and behaviour of reinforced composite materials for specific applications and developing composite materials for sustainability

CO2: formulate different types of reinforcement and matrices to develop new composite material for the various application

CO3: design and manufacture post processing methods of composite structures and capable to perform various analysis

CO4: execute different methods of manufacturing advanced composites to meet the innovate demand in engineering.

CO5: fabricate metal matrix, ceramic matrix and carbon matrix composite for various engineering application to meet the societal demand.

Course Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	H			M	M				L				
CO2	H	M	M	M	M		L				M				
CO3	M	M	M	M		L	M				L				
CO4	M	M	M	L		H	L		L		M				
CO5	L	L		L		M	L					L			
16MOEX09	M	M	M	L	L	M	L		L		L	L			

L- Low, M – Moderate (Medium), H - High

16MOEX10 **AUTOMOBILE ENGINEERING** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- The learners are able to visualize the scope of Automobile Engineering.

UNIT- I	**INTRODUCTON TO AUTOMOTIVES**	**(09)**
An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design		
UNIT- II	**POWER SOURCE FEATURES**	**(09)**
Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems - Pollutant emissions and their control; Catalytic converter systems, Electronic Engine management systems.		
UNIT- III	**TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS**	**(09)**
Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and Preliminaries of suspension systems.		
UNIT- IV	**AUXILIARY SYSTEMS**	**(09)**
Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.		
UNIT- V	**TESTS, SERVICE AND MAINTENANCE**	**(09)**
Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions Check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Dr. Kirpal Singh	*Automobile Engineering Vol. I & II*	*Standard Distributors Publishers, 2012.*
R.B.Gupta	*Automobile Engineering*	*Sathya Prakashan, New Delhi, 2006*

Reference Books:

1. William H.Crouse, "Automotive Mechanics", McGraw Hill Book Co. 2004.

2. K.K. Ramalingam, "Automobile Engineering – theory and Practice" SciTech Publications, 2001.

3. Joseph Heinter "Automobile Mechanics Principles and Practice" Affiliated East West Press, 1997.

4. Jain K.K. and Asthana. R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

5. Heinz Heisler, "Advanced Engine Technology" SAE International Publications USA, 1998.

Course Outcomes:

On completion of this course, learners will be able to

CO1: Identify the different components in an automobile.

CO2: Clearly understand different auxiliary and transmission systems.

CO3: Explain the working of various parts like engine, transmission, clutch, brakes

CO4: Understand the environmental implications of automobile emissions

CO5: Develop a strong base for understanding future developments in the automobile industry

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M	M	L	H	M	M	M	L	L	L	H			
CO2	H	M	H	H	M	H	L	L	L	M	M	L			
CO3	M	M	M	L	M	H	M	L	L	M	H	L			
CO4	H	M	H	M	H	M	H	H	M	M	H	L			
CO5	M	L	L	L	M	H	M		L	H	H	H			
16MOEX10	M	M	M	M	H	H	M	L	L	M	M	M			

L- Low, M – Moderate (Medium), H - High

16EOEX11 RENEWABLE ENERGY SOURCES AND TECHNOLOGY **Category**: OE

(Common to all Branches)

Pre-Requisites: Nil

L	T	P	C
3	0	0	3

Course Objective:

- To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT- I	**SOLAR ENERGY**	**(09)**
Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.		
UNIT- II	**WIND ENERGY**	**(09)**
Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application.		
UNIT- III	**BIOMASS ENERGY**	**(09)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.		
UNIT- IV	**OCEAN AND GEOTHERMAL ENERGY**	**(09)**
Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC. Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation.		
UNIT- V	**RENEWABLE ENERGY POLICIES**	**(09)**
Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Rao. S. and Dr. Pamlekar B.B,	*Energy Technology*	*Khanna Publishers, Second Ed. 1997*
Pai and Ramaprasad	*Power Generation through Renewal sources*	*Tata McGraw Hill – 1991*

Reference Books:

1. Rai , G.D., "NonConventional sources of Energy", Khanna Publishers , IV Ed.,2009
2. Bansal NK, Kleeman and Meliss, M "Renewable Energy Sources and Conversion Techniques", Tata McGraw Hill, 1996
3. Roland Wengenmayr, Thomas Buhrke, "Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.

Course Outcomes:

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

CO1: Realize the need for utilizing the energy from clean and Sustainable energy resources.
CO2: Describe the principles of operation of the broad spectrum of renewable energy Technologies
CO3: Analyze energy technologies from a systems perspective.
CO4: Articulate the technical challenges for each of the renewable sources
CO5: Create solutions for alternate energy issues
CO6: Discuss economic, technical and sustainability issues involved in the integration of renewable energy systems

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M	M	M	M			L	L	L			
CO2	H	H	M	M	M	M	M	L		L	L	L			
CO3	H	M	M	M	M	M	M	M			L	L			
CO4	M	H	M	L	M	H	M	M		L	L	L			
CO5	M	H	H	H	M	M	M	M		L	L	L			
CO6	H	M	M	M	M	M	M		H	H	L	L			
16EOEX11	H	H	M	M	M	M	M	L	L	L	L	L			

L- Low, M – Moderate (Medium), H - High

16EOEX12 **SMART GRID TECHNOLOGY** Category: OE

(Common to all Branches)

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objective:

- To gain knowledge on the fundamentals of smart grid technologies, its architecture and its managements. Also the students should learn many of the challenges facing the smart grid as part of its evolution.

UNIT- I	**SMARTGRIDS: MOTIVATION, STAKES AND PERSPECTIVES**	**(09)**
Introduction – Information and Communication technologies serving the electrical system – Integration of advanced technologies – Definitions of SmartGrids – Objectives addressed by the SmartGrid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the Smart Grid concept – Research and scientific aspects of the Smart Grid – SmartGrids from the customer's point of view.		
UNIT- II	**INFORMATION AND COMMUNICATION TECHNOLOGY**	**(09)**
Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, standards for information Exchange, Information security for the smart grid - Cyber Security Standards - IEEE1686 - IEC62351.		
UNIT- III	**SENSING AND MEASUREMENT**	**(09)**
Synchro Phasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.		
UNIT- IV	**CONTROL AND AUTOMATION**	**(09)**
Distribution automation equipment – Substation automation equipments: current transformer, potential transformer, Intelligent Electronic Devices, Bay controller, Remote Terminal Unit. Distribution management systems – SCADA: modeling and analysis tools, applications		
UNIT- V	**REGULATION OF SMARTGRIDS AND ENERGY STORAGE SYSTEMS**	**(09)**
Regulation and Economic models – Evolution of the value chain – The emergence of a business model for smart grids – Regulation can assist in the emergence of SmartGrids – The standardization of SmartGrids - Energy Storage Technologies-Methods - Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheel, Super-Conducting magnetic energy storage system, Super Capacitor.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage	*Smart Grid Technologies and applications*	*John Wiley Publishers Ltd., 2012.*
Nouredine Hadjsaid, JeanClaude Sabonnadiere	*Smart Grids*	*Wiley Publishers Ltd., 2012*
Lars T. Berger, Krzysztof Iniewski	*Smart Grid applications, Communications and Security*	*John Wiley Publishers Ltd., 2012.*

Reference Books:

1. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press Taylor and Francis Group, 2012.

2. Caitlin G. Elsworth,"The Smart Grid and Electric Power Transmission", Nova Science Publishers Inc, 2010

Course Outcomes:

CO1: Develop and demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures, Applications.

CO2: Design a smart grid and to meet the needs of a utility, including Meeting a utility's objectives, helping to adopt new technologies into the grid.

CO3: Creating a framework for knowledgeable power engineers to operate the grid more effectively.

CO4: Transfer the available information from any part of the power system to centralized control centre.

CO5: Handle the smart meter, sensors and intelligent devices to measure the electrical quantity.

CO6: Control the Electrical quantity from remote place.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1				L	L	M	H	L	M	M	M	H			
CO2	L	L	M	M	M	M	M	L	M	M	M	M			
CO3				M	M	M	M	M	M	M	M	H			
CO4	L			M	M	M	H		M	M	M	H			
CO5	M		L	M	M	M	M		M	M	M	M			
CO6	L	L	M	L	M	M	L		M	M	M	M			
16EOEX12	L	L	L	M	M	M	M	L	M	M	M	H			

L- Low, M – Moderate (Medium), H – High

16LOEX13 **PRINCIPLES OF COMMUNICATION** Category: OE

(Common to all Branches)

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To understand the concepts of analog communication
- To gain the fundamental knowledge of digital communication
- To be familiar with the fundamentals of satellite and optical communication

UNIT- I	**AMPLITUDE MODULATION**	**(09)**
Introduction to communication systems- Electromagnetic spectrum- Principle of amplitude modulation − AM envelope − frequency spectrum and bandwidth − modulation index and percentage of modulation −AM power distribution–AM generation and-detection – square law modulator- envelope detector.		
UNIT- II	**ANGLE MODULATION**	**(09)**
Frequency modulation and phase modulation- FM and PM waveforms − phase deviation and modulation index − frequency deviation and percentage of modulation −Frequency analysis of angle modulated waves- Bandwidth requirements for Angle modulated waves – generation and detection of FM – Armstrong modulator- Foster Seely Discriminator.		
UNIT- III	**PULSE MODULATION**	**(09)**
Sampling and Quantization – Pulse Amplitude modulation- Pulse width modulation –Pulse position modulation- Pulse code modulation- PCM transmitter and receiver - Signal to Quantization noise ratio – Differential Pulse Code Modulation − Delta modulation − Adaptive Delta modulation		
UNIT- IV	**DIGITAL COMMUNICATION**	**(09)**
Introduction – ASK, FSK,PSK- transmitter and receiver – QPSK transmitter and receiver – M ary PSK – Error probability in PSK, FSK.		
UNIT- V	**SATELLITE AND OPTICAL COMMUNICATION**	**(09)**
Satellite Communication Systems-Transmitter and receiver- Kepler's Law –LEO and GEO Orbits – GEO Stationary orbit-–Optical Communication Systems– Transmitter and receiver-Sources and Detectors- Types of Optical Fiber – Losses		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Wayne Tomasi	*Advanced Electronic Communication Systems*	6/e,Pearson Education, 2007.
Simon Haykin	*Communication Systems*	*4th Edition, John Wiley & Sons., 2008.*

Reference Books:

1. H.Taub, D L Schilling, G Saha , "Principles of Communication"3/e,2007.

2. B.P.Lathi, "Modern Analog and Digital Communication systems", 3/e, Oxford University Press, 2007.

3. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.

4. B.Sklar, "Digital Communication Fundamentals and Applications", 2/e Pearson Education 2007.

Course Outcomes:
Upon completion of this course, the students will have the

CO1: Basic knowledge of amplitude modulation systems.

CO2: Basic knowledge of angle modulation systems.

CO3: Fundamental knowledge of digital communication systems.

CO4: Understanding of digital transmission techniques.

CO5: Fundamental knowledge of satellite communication system.

CO6: Fundamental knowledge of optical communication system.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M									L			
CO2	M	M	M									L			
CO3	M	M	M									L			
CO4	M	M	M									L			
CO5	M	M	M									L			
CO6	M	M	M									L			
16LOE X13	M	M	M									L			

Low, M – Moderate (Medium), H - High

16LOEX14 **MICROCONTROLLERS AND ITS APPLICATIONS** **Category**: OE

(Common to all Branches)

L T P C
3 0 0 3

Pre-Requisites: Nil

Course Objectives:

- To gain knowledge on basics of microcontrollers
- To get exposure to programming of microcontroller 8051
- To acquire knowledge on interfacing of peripherals with 8051 and PIC microcontrollers
- To get exposure on applications of microcontrollers

UNIT- I	**INTRODUCTION TO MICROCONTROLLER**	**(09)**
Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family - PIC 18FXXX – family – Memory organization		
UNIT- II	**PROGRAMMING OF 8051 MICROCONTROLLER**	**(09)**
Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.		
UNIT- III	**PROGRAMMING OF PIC18FXXX MICROCONTROLLER**	**(09)**
Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication, CCP, ECCP PWM programming of PIC18FXXX.		
UNIT- IV	**PERIPHERAL INTERFACING**	**(09)**
Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I^2C, SPI with 8051 and PIC family.		
UNIT- V	**MICROCONTROLLER APPLICATIONS**	**(09)**
Pulse measurement-measuring frequency, pulse width measurement -Speed control of DC Motor-Speed control of Stepper Motor-Traffic Light Controller and Washing Machine Controller.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Kenneth J.Ayala	*The 8051 Microcontroller*	*3rd Edition, Thompson Delmar Learning, 2007, New Delhi.*
JohnB. Peatman	*PIC programming*	*McGraw Hill International, USA, 2005.*

Reference Books:

1.Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems" Pearson Education, Inc 2006.

2.John B. Peatman, "Design with Micro controllers", McGraw Hill International, USA, 2005

3.James W. Stewart, "The 8051 Micro controller hardware, software and interfacing", regents Prentice Hall, 2003.

4.David Calcutt, Fred Cowan, Hassan Parchizadeh, "8051 Microcontroller An Application Based Introduction", Elsevier Publication, 1st edition,2004.

5.Krishna Kant, "Microprocessor and Microcontrollers" Eastern company edition, Prentice Hall of India, New Delhi, 2007.

Course Outcomes:

Upon completion of this course the student will:

CO1: Acquire knowledge on the basics of microcontroller

CO2: Exposure to 8051 microcontroller Programming

CO3: Exposure to PIC microcontroller Programming

CO4: Able to interface peripherals with microcontrollers

CO5: Get exposure to the applications of microcontrollers

CO6: Able to design microcontroller based systems

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M									L			
CO2	M	H	M									M			
CO3	M	H	M									M			
CO4	M	H	M									M			
CO5	M	H	M									M			
CO6	H	H	H									M			
16LOEX14	M	H	M									M			

L- Low, M – Moderate (Medium), H - High

16NOEX15 **INDUSTRIAL AUTOMATION SYSTEMS** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To elaborate the basic concept of automation and the components required for automation.
- To introduce the concept and programming of programmable logic controllers and distributed control system which is used for process automation.
- To outline the basic concepts of SCADA technology.

UNIT- I	**INTRODUCTION TO AUTOMATION**	**(09)**
Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors –seal-in circuits – industrial bus systems : modbus and profibus.		
UNIT- II	**AUTOMATION COMPONENTS**	**(09)**
Sensors for temperature – pressure – force – displacement - speed – flow- level – humidity and pH measurement. Actuators – process control valves – power electronic drives DIAC- TRIAC – power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control		
UNIT- III	**PROGRAMMABLE LOGIC CONTROLLERS**	**(09)**
PLC Hardware – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.		
UNIT- IV	**DISTRIBUTED CONTROL SYSTEM (DCS)**	**(09)**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers		
UNIT- V	**SCADA**	**(09)**
Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
John.W. Webb Ronald A Reis	*Programmable Logic Controllers - Principles and Applications*	*Prentice Hall Inc., 5th Edition, 2003*
M. P. Lukcas,	*Distributed Control Systems*	*Van Nostrand Reinhold Co., 1986.*

Reference Books:

1. Bela G Liptak, "Process software and digital networks – Volume 3", 4th Edition, CRC press, 2012.

2. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw Hill, 2016.

3. Huges T, "Programmable Logic Controllers", ISA press, 1994

4. Romily Bowden, "HART application guide and the OSI communication foundation", 1999

5. Krishna Kant, "Computer Based Industrial Control" Second edition, Prentice Hall of India, New Delhi, 2010

Course Outcomes:

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

CO1: Elaborate the basic architecture of automation systems

CO2: Describe the various sensors and actuators involved in industrial automation

CO3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams.

CO5: Describe the basics of SCADA technology

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	H	H	M	M	L	L	L	H	L	M	L	L			
CO2	H	H	H	H	L	L	L	H	L	M	L	L			
CO3	H	H	M	M	L	L	M	H	L	M	L	L			
CO4	H	H	H	H	L	L	L	H	L	M	L	L			
CO5	H	H	M	M	M	L	L	H	L	M	L	L			
16NOEX15	H	H	M	M	L	L	L	H	L	M	L	L			

L- Low, M – Moderate (Medium), H - High

16NOEX16 **MEASUREMENTS AND INSTRUMENTATION** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- To study about the electrical parameter measuring instruments.
- To familiarize about the measurement techniques for power and energy.
- To gain knowledge about potentiometer and instrument transformers.
- To learn about the working of different analog and digital instruments.
- To study about display and recording devices.

UNIT- I	**MEASUREMENT OF ELECTRICAL PARAMETERS**	**(09)**
Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wien Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.		
UNIT- II	**POWER AND ENERGY MEASUREMENTS**	**(09)**
Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.		
UNIT- III	**POTENTIOMETERS AND INSTRUMENT TRANSFORMERS**	**(09)**
D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.		
UNIT- IV	**ANALOG AND DIGITAL INSTRUMENTS**	**(09)**
Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement.		
UNIT- V	**DISPLAY AND RECORDING DEVICES**	**(09)**
Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays – X-Y recorders – Magnetic tape recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Kalsi. H.S	*Electronic Instrumentation*	*Tata McGraw-Hill, New Delhi, 2010*
Sawhney.A.K,	*A Course in Electrical & Electronic Measurements & Instrumentation*	*Dhanpat Rai and Co., New Delhi, 2010*

Reference Books:

1. *Northrop. R.B, "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 2008.*
2. *2.Carr.J.J, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.*
3. *David A.Bell, "Electronic Instrumentation and Measurements", PHI, New Delhi.*
4. *Copper. W.D and Hlefrick..A.D, "Modern Electronic Instrumentation and Measurement Technique" 5th Edition, Prentice Hall of India, 2002.*

Course Outcomes:

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

CO1: Compare the working principles, merits and demerits of different types of electrical instruments and can understand about different instruments that are used for Measurement purpose.

CO2: Understand how different bridge networks are constructed and balanced for finding the values of resistance, capacitance and inductance.

CO3: Apply knowledge of electronic instrumentation for measurement of electrical quantities.

CO4: Apply the principles and practices for instrument design and development to real world problems.

CO5: Select a suitable measuring instrument for a given application.

CO6: Pursue higher studies and do research activities in the field of measurement and instrumentation.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	H	M	H	M	L	H	M	H	H			
CO2	H	M	M	M	H	H	H	M	H	L	H	H			
CO3	H	H	M	H	M	H	M	L	H	M	H	H			
CO4	H	H	M	H	M	H	M	L	H	M	H	H			
CO5	H	H	M	H	M	H	M	L	H	M	H	H			
CO6	H	H	M	H	M	H	M	L	H	M	H	H			
16NOEX16	H	H	M	H	M	H	M	L	H	M	H	H			

L- Low, M – Moderate (Medium), H - High

16SOEX17 **ENTERPRISE JAVA** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course, the students will be familiar with

- Basic programming constructs in java to develop simple object oriented programs
- Enterprise Architecture types and features of Java EE platform
- JEE foundation concepts like Enterprise java bean, JSP and JSF
- Distributed Programs and methods to connect with database.
- Java Web services

UNIT- I	**INTRODUCTION TO JAVA**	**(09)**
Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling – Networking –Applet class – Event Handling.		
UNIT- II	**INTRODUCTION TO ENTERPRISE JAVA**	**(09)**
Challenges of Enterprise application Development - Platform for enterprise Solutions – J2EE Application Scenario - J2EE Platform Technologies –J2EE Multi-Tier Architecture - J2EE Architecture Approaches - Model-View-Controller Architecture - J2EE Design Patterns - Designing the Sample Application - Choosing Application Tiers - Choosing Local or Distributed Architecture - Architecture of the Sample Application		
UNIT- III	**ENTERPRISE JAVA FOUNDATION**	**(09)**
Enterprise Java Beans -Business Logic and Business Objects. - Enterprise Beans as J2EE Business Objects - Entity Beans - Session Beans - Message-Driven Beans -Transaction support in EJB- Security support in EJB –Java Server Pages - Directive Elements - Scripting Elements - Action Elements- Expression Language-JSP Standard Tag Library - Java Server Page Online Store –JavaServer Faces - Life Cycle - Resource Management.		
UNIT- IV	**INTERCONNECTIVITY**	**(09)**
Concept of JDBC – JDBC Driver types- Database Connection – Associating JDBC Bridge with the database – Statement Objects –Resultset – Transaction Processing – RMI- Network File-Locking Server -Java Mail API and Java Activation Framework – send ,receive, retrieve and delete email message - Java Message Service – JMS Fundamentals –Components of a JMS program -JMS architecture –JMS-Based Alarm System - JNDI – Naming and Directories – Naming Operations		
UNIT- V	**WEB SERVICES**	**(09)**
SOAP Basics – Java API for XML Messaging – Creating a SOAP Attachment – Accessing a SOAP Attachment – Universal Description, Discovery and Integration (UDDI)- UDDI Architecture – UDDI Application Programming Interface – Inquiry Application Programming Interface – Publishing Application Programming Interface –JAXR – JAXR client – Publishing a service to an XML Registry – Removing a published service from an XML Registry- WSDL – Inside WSDL- WSDL and SOAP - RESTFul Web services – REST Approach - Java API for RESTful Web service		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Herbert Schildt	*Java The Complete Reference*	*9th Edition. Tata McGraw- Hill Edition. 2014.*
Stephen Asbury and Scott R. Weiner	*Developing Java Enterprise Applications*	*second edition Wiley Publishing.1999.*
Antonio Goncalves	*Beginning Java™ EE 6 Platform with GlassFish™ 3From Novice to Professional*	*Apress 2009*
Jim Keogh	*The Complete Reference J2EE*	*Tata McGraw –Hill 2002*

Reference Books:

1.John Brock, Arun Gupta, GeertjanWielenga "Java Server Programming Java EE 7 (J2EE 1.7) - Black Book" McGraw Hill, 2015.

2.Inderjeet Singh, Beth Stearns, Mark Johnson, and the Enterprise Team "Designing Enterprise Applications with the J2EE™ Platform", Second Edition Addison Wesley, 2002.

Course Outcomes:

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

CO1: Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces, multithreaded programming and exception handling. [**Usage]**

CO2: Write java program for Networking using applets. **[Usage]**

CO3: Describe and use the client/server and distributed architectures in a programming Environment. **[Usage]**

CO4: Use EJB, JSP and JFC technology in developing enterprise applications **[Usage]**

CO5: Apply Java interconnectivity techniques like JDBC, RMI, Java Mail, JMS, JNDI in developing enterprise applications**[Usage]**

CO6: Explain the roles XML, JAXR, SOAP, WSDL and UDDI in the architecture of Web services. **[Familiarity]**

CO7: Develop java program to use RESTful web services **[Assessment]**

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L	H	L	H		L					M			
CO2	H	M	H	M	H		L					M			
CO3	H	L	H	L	H		L					M			
CO4	M	L	M	L	H		L					M			
CO5	H	L	H	L	H		M					M			
CO6	M	L	M	L	H		L					L			
CO7	H	L	H	L	H		M					M			
16SOEX17	H	L	H	L	H		L					M			

L- Low, M – Moderate (Medium), H – High

16SOEX18 **CYBER SECURITY** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses.
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

UNIT- I	**INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES**	**(09)**
Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks -Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.		
UNIT- II	**CYBERCRIME: MOBILE AND WIRELESS DEVICES**	**(09)**
Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.		
UNIT- III	**TOOLS AND METHODS USED IN CYBERCRIME**	**(09)**
Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.		
UNIT- IV	**CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES**	**(09)**
Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.		
UNIT- V	**UNDERSTANDING COMPUTER FORENSICS**	**(09)**
Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Nina Godbole and Sunit Belapur,	*Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*	*Wiley India Publications, April, 2011*

Reference Books:

1.Robert Jones, "Internet Forensics: Using Digital Evidence to Solve Computer Crime", O'Reilly Media, October, 2005.

2.Chad Steel, "Windows Forensics: The field guide for conducting corporate computer investigations", Wiley India Publications, December, 2006.

Course Outcomes:

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

CO1: Explain the fundamental concepts of cybercrime and cyber offenses. [Familiarity]

CO2: Describe the cybercrimes occurred in mobile and wireless devices. [Familiarity]

CO3: Elaborate the methods used in cybercrime. [Familiarity]

CO4: Explain the laws for cybercrime and its respective punishments. [Familiarity]

CO5: Explain the forensics Analysis of E-Mail, Network and Social Networking Sites [Familiarity]

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	M	L	H	L	M				H			
CO2	M	M	M	M	M	H	M	M				M			
CO3	H	L	L	L	L	H	H	L				H			
CO4	H	M	M	M	M	H	H	H				M			
CO5	H	M	M	M	M	L	H	L				H			
16SOEX18	H	M	M	M	M	H	H	M				H			

L- Low, M – Moderate (Medium), H - High

16SOEX19 **NETWORK ESSENTIALS** Category: OE

(Common to all Branches) L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course, the students will be familiar with:

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

UNIT- I	**INTRODUCTION**	**(09)**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics		
UNIT- II	**WIRELESS NETWORKING**	**(09)**
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation.		
UNIT- III	**ADDRESSING AND ROUTING FUNDAMENTALS**	**(09)**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet.		
UNIT- IV	**ROUTING PROTOCOLS**	**(09)**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP , DNS - Analyzing Internet Traffic.		
UNIT- V	**TROUBLESHOOTING AND NETWORK SECURITY**	**(09)**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Jeffrey S.Beasley Piyasat Nilkaew	*Network Essentials*	*3rd Edition, Pearson, 2012*
Larry L. Peterson and Bruce S. Davie	*Computer Networks, A Systems Approach*	*Morgan Kaufmann Publishers Inc, 5th edition 2011*

Reference Books:

1. Behrouz A.Ferouzan, "Data Communications and Networking", 5th edition, Tata McGraw-Hill, 2012.

2. Andrew S. Tanenbaum, "Computer networks's, PHI, 5th edition 2011.

Course Outcomes:

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

- **CO1:** Identify topologies and types of Computer Networks **[Familiarity]**
- **CO2:** Enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**
- **CO3:** Identify and Compare types of cabling for data communication **[Usage]**
- **CO4:** Explain the significance of wireless networks **[Familiarity]**
- **CO5:** Configure a Wireless LAN **[Assessment]**
- **CO6:** Configure router and a switch **[Assessment]**
- **CO7:** Describe basic routing algorithms and network services **[Usage]**
- **CO8:** Troubleshoot the router and switch interface **[Usage]**
- **CO9:** Analyze Campus Network data traffic **[Usage]**

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	H	H	H	L	L	H	H	H	H	H			
CO2	H	H	H	H	H	L	L	H	H	H	H	H			
CO3	L	L	L	L	H	L	L	H	L	L	L	H			
CO4	L	H	M	M	H	L	L	H	H	M	L	H			
CO5	H	H	H	M	H	L	L	H	H	H	M	H			
CO6	H	H	H	M	H	L	L	H	H	M	L	H			
CO7	H	H	H	H	H	L	L	H	H	H	M	H			
CO8	H	H	H	H	H	L	L	H	H	M	L	H			
CO9	H	H	H	H	H	L	L	H	H	H	M	H			
16SOEX19	M	H	H	M	H	L	L	H	H	L	M	H			

L- Low, M – Moderate (Medium), H - High

16IOEX20 **PROGRAMMING IN PYTHON** Category: OE

(Common to all Branches)

L T P C

3 0 0 3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Control statements, Functions and the use of basic programming.
- List, dictionary and functions used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT- I	**INTRODUCTION**	**(09)**
Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method–Converting values.		
UNIT- II	**CONTROL STATEMENTS AND FUNCTIONS**	**(09)**
Control statements – Random number generator- Branching and loops – Range functions- Functions – User defined functions- passing parameters- return function- working withglobal variables and constants.		
UNIT- III	**LISTS AND DICTIONARIES**	**(09)**
Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.		
UNIT- IV	**FILES AND EXCEPTIONS**	**(09)**
Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program's execution.		
UNIT- V	**OBJECT ORIENTED PROGRAMMING AND GUI**	**(09)**
Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Y. Daniel Liang	*Introduction to Programming Using Python*	*Pearson, 2013.*
Charles Dierbach	*Introduction to Computer Science Using Python: A Computational Problem-Solving Focus*	*Wiley Publications, 2012.*

Reference Books:

1.Michael Dawson "Python Programming for the Absolute Beginner", Premier Press, 2003.

Course Outcomes:

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

CO1: Use various data types **[Understand]**

CO2: Handle the arrangement of data elements in Lists and Dictionary structures **[Analyze]**

CO3: Use control statements and functions **[Understand]**

CO4: Handle exceptions and perform file operations **[Understand]**

CO5: Develop application using object oriented programming and GUI **[Analyze]**

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L		L	L		L	L			L				
CO2	M	L		L	L		L	L			L				
CO3	M	M	L	M	L		L	L			L				
CO4	M	M	L	M	L		M	M			L				
CO5	M	M	L	M	L		M	M			M	L			
16IOE X20	M	M	L	M	L		L	L			L	L			

L- Low, M – Moderate (Medium), H - High

16IOEX21 **BIG DATA SCIENCE** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics
- Technologies used for Big Data Storage and Analysis
- Mining larger data streams
- Concepts related to Link analysis and handle frequent data sets

UNIT- I	**THE FUNDAMENTALS OF BIG DATA**	**(09)**
Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study		
UNIT- II	**BIG DATA STORAGE AND PROCESSING**	**(09)**
Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding - Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study		
UNIT- III	**BIG DATA STORAGE AND ANALYSIS TECHNOLOGY**	**(09)**
Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study		
UNIT- IV	**MINING DATA STREAMS**	**(09)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- dis tance measures – methods for high degree similarity.		
UNIT- V	**LINK ANALYSIS AND FREQUENT ITEMSETS**	**(09)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Thomas Erl, WajidKhattak, and Paul Buhler	*Big Data Fundamentals Concepts, Drivers & Techniques*	*Prentice Hall,2015*
AnandRajaraman and Jeffrey David Ullman	*Mining of Massive Datasets*	*Cambridge University Press, 2012.*

Reference Books:

1.Paul Zikopoulos, Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill, 2011.

2.Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.

Course Outcomes:

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

CO1: Understand the Big Data and usage in Enterprise Technologies. [Understand]

CO2: Store and Process Big Data using suitable Processing Methods [Understand]

CO3: Handle Big Data using appropriate analysis Techniques. [Analyse]

CO4: Mine larger data streams using suitable algorithms. [Understand]

CO5: Rank pages and handle large data sets efficiently [Analyse]

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L	M	L	H	L									
CO2	M				H			L							
CO3		H			H										
CO4	M	H	M		M										
CO5	L	M	H												
16IOEX21	M	M	L	L	M	L		L							

L- Low, M – Moderate (Medium), H - High

16IOEX22 **OBJECT ORIENTED PROGRAMMING USING C++** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

.Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming .
- Classes and objects.
- Concepts of overloading and type conversions.
- Inheritance and Polymorphisms.
- Files, templates and exception handling.

UNIT- I	**PRINCIPLES OF OBJECT ORIENTED PROGRAMMING**	**(09)**
Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.		
UNIT- II	**CLASSES AND OBJECTS**	**(09)**
Introduction – specifying class – defining member functions – memory allocation constructors and destructors:- parameterized- copy – default -dynamic and multiple constructors – destructors		
UNIT- III	**FUNCTIONS AND TYPE CONVERSIONS**	**(09)**
Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions		
UNIT- IV	**INHERITANCE AND POLYMORPHISM**	**(09)**
Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors.		
UNIT- V	**FILES AND TEMPLATES**	**(09)**
Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
E.Balagurusamy	*Object oriented Programming with C++*	*McGraw Hill Education Ltd,6th Edition 2013.*

Reference Books:

1.R.Rajaram "Object Oriented Programming and C++" New Age International 2nd edition , 2013

2.K.R. Venugopal,Rajkumar,T. Ravishankar "Mastering C++" , Tata McGraw Hill Education,2nd edition, 2013

3.Yashavant P. Kanetkar"Let us C++" BPB Publications , 2nd edition 2003.

Course Outcomes:

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

CO1: Understand the principles of object oriented programming [Understand]

CO2: Develop programs using classes and objects.[Analyze]

CO3: Use functions and type conversions in programs. [Understand]

CO4: Apply inheritance and polymorphism to develop applications. [Analyze]

CO5: Use files, templates and handle exceptions. [Understand]

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	H	M	M		M	M			M				
CO2	M	H	H	H	M		M	M			M				
CO3	M	H	H	H	M		M	M			M				
CO4	M	H	H	H	M	L	M	M			M				
CO5	M	H	H	H	M		M	M			M				
16IOEX22	M	H	H	H	M	L	M	M			M				

L- Low, M – Moderate (Medium), H - High

16BOEX23 **COMPUTATIONAL BIOLOGY** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

- Understand the basic concepts and role of computation in biological analysis.
- Familiarize with sequence alignment methods.
- Understand the machine learning tools used for biological analysis.

UNIT- I	**BASICS OF BIOLOGY**	**(09)**
Biomolecules of life:Structure and Composition of DNA, RNA & Protein. Protein Structure basics-Primary, Secondary and tertiary Structure of protein.		
UNIT- II	**BIOLOGICAL DATABASES**	**(09)**
Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI, EMBL, DDBJ; Structure databases-PDB.		
UNIT- III	**SEQUENCE ANALYSIS**	**(09)**
Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith waterman and Needleman wunsch algorithm, Heuristic methods- BLAST, FASTA; Multiple sequence alignment methods-Progressive alignment (Clustal).		
UNIT- IV	**STRUCTURE ANALYSIS AND DRUG DESIGN**	**(09)**
Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.		
UNIT- V	**MACHINE LEARNING**	**(09)**
Genetic Algorithm, Neural networks, Artificial Intelligence, Hidden markov model - application in bioinformatics.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
David W. Mount	*Bioinformatics: Sequence and Genome Analysis*	*Cold Spring Harbor Laboratory Press, Second Edition, 2004.*
Arthur M. Lesk,	*Introduction to Bioinformatics*	*Oxford University Press, 2008.*
Pierre Baldi, Soren Brunak	*Bioinformatics: The machine learning approach*	*MIT Press, 2001*

Reference Books:

1.Andrew R. Leach, "Molecular Modeling Principles And Applications", Second Edition, Prentice Hall, 2001.

2.Baxevanis A.D. and Oullette, B.F.F, "A Practical Guide to the Analysis of Genes and Proteins", 2nd ed., John Wiley, 2002

3.David L. Nelson,Michael M. Cox , "Lehninger Principles of Biochemistry", Sixth edition, Freeman, W. H. &Co. Publisher,2012.

Course Outcomes:

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

CO1: Understand basic structure of Biological macromolecules

CO2: Acquire the knowledge of biological databases

CO3: Ability to perform pair wise and multiple sequence alignment

CO4: Ability to predict the secondary and tertiary structure of proteins.

CO5: Understand the machine learning approaches in computational biology

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L		L			M						
CO2	M	L	L	L					L			L			
CO3	L		L			M			L			L			
CO4	M	M	L	M	M										
CO5		M		H	H	M	L		M						
16BOEX23	L	L	L	L	L	L	L		L			L			

L- Low, M – Moderate (Medium), H - High

16BOEX24 **BIOLOGY FOR ENGINEERS** Category: OE

(Common to all Branches)

Pre-Requisites: Nil

L	T	P	C
3	0	0	3

Course Objectives:

To enable the students

- To understand the basic functions of the cell and their mechanisms in transport process
- To get familiarize human anatomy and physiology
- To learn about microbes, immune system and biomolecules
- To know the concepts of applied biology

UNIT- I	**BASICS OF CELL BIOLOGY**	**(09)**
An Overview of cells – Origin and evolution of cells. Cell theory, Classification of cells – prokaryotic cells and eukaryotic cells. Structure of prokaryotic and eukaryotic cells and their organelles. Comparison of prokaryotic and eukaryotic cells, Transport across membranes – diffusion - active and passive diffusion.		
UNIT- II	**BASICS OF MICROBIOLOGY**	**(09)**
Classification of microorganism, Microscopic examination of microorganisms, Structural organization and multiplication of bacteria, viruses, algae and fungi, Microorganism used for the production of penicillin, alcohol and vitamin B-12.		
UNIT- III	**HUMAN ANATOMY AND PHYSIOLOGY**	**(09)**
Basics of human anatomy, tissues of the human body: epithelial, connective, nervous and muscular, Nervous system, Respiratory System, Circulatory system and Digestive system.		
UNIT- IV	**BIO MOLECULES AND IMMUNE SYSTEM**	**(09)**
Introduction to Biochemistry, Classification, structure and properties of carbohydrates, proteins, lipids and nucleic acids. Innate and acquired immunity, Types of immune responses.		
UNIT- V	**APPLIED BIOLOGY FOR ENGINEERS**	**(09)**
Overview of biosensors- glucometer applications-medicine, Microarray analysis to diagnose the cancer, Microbial production of biofuels, Applications of stem cells.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Darnell J, Lodish H, Baltimore D	*Molecular Cell Biology*	*W.H.Freeman; 8th edition,2016*
Pelczar MJ, Chan ECS and KreinNR,	*Microbiology*	*Tata McGraw Hill, 5th edition, New Delhi.2001.*
WulfCruger and AnnelieseCruger	*A Textbook of Industrial Microbiology*	*Panima Publishing Corporation, 2nd Edition, 2000.*

Reference Books:

1.David L. Nelson and Michael M Cox, "Lehninger's Principles of Biochemistry", Macmillan Worth Publisher, 4th edition, 2004.

2.Brain R.Eggins ,"Chemical Sensors and Biosensors", John Wiley & Sons, 2002

3.Anton Moser, "Bioprocess Technology, Kinetics and Reactors" Springer, Berlin (Verlag),1998

4.Kuby J, "Immunology", WH Freeman & Co., 2000.

Course Outcomes:

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

CO1: Understand the functions of cell and their structural organization

CO2: Describe the mechanisms and role of cell in immune system

CO3: Get familiarized biomolecules and human anatomy system

CO4: Illustrate the applications of microbes in industrial process

CO5: Apply the engineering concepts in biology

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L		L	M		L		L	M	L			
CO2	L		L	L	L	M	M		L	L	L	L			
CO3	L	L			L	L	L	L	L		L	L			
CO4	L		L		L			L		L	L	L			
CO5															
16BOEX24	L	L	L	L	L	L	L	L	L	L	L	L			

L- Low, M – Moderate (Medium), H - High

16BOEX25 **FUNDAMENTALS OF BIOENGINEERING** Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives:

To make the students aware of the overall industrial bioprocess.

- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

UNIT- I	**INTRODUCTION TO INDUSTRIAL BIOPROCESS**	**(09)**
Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.		
UNIT- II	**FERMENTATION INDUSTRY**	**(09)**
Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.		
UNIT- III	**PRODUCTION OF PRIMARY METABOLITES**	**(09)**
A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.		
UNIT- IV	**PRODUCTION OF SECONDARY METABOLITES**	**(09)**
Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12		
UNIT- V	**PRODUCTS THROUGH MODERN BIOTECHNIQUES**	**(09)**
Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Peter F. Stanbury, Stephen J. Hall & A. Whitaker	*Principles of Fermentation Technology*	*Science & Technology Books. 1995.*
Presscott, S.C. and Cecil G. Dunn	*Industrial Microbiology*	*Agrobios (India), 2005*
Casida, L.E	*Industrial Microbiology*	*New Age International (P) Ltd, 1968.*

Reference Books:

1.Crueger, W and AnnelieseCrueger, Biotechnology: "A Textbook of Industrial Microbiology", Panima Publishing Corporation, Edition 2, 2003

2.Sathyanarayana, U., "Biotechnology", Books and Allied (P) Ltd. Kolkata, 2005

3.Ratledge C and Kristiansen B. "Basic Biotechnology", Cambridge University Press, second Edition, 2001.

4.Michael J. Waites. "Industrial Microbiology: An Introduction", Blackwell Publishing,2001.

Course Outcomes:

CO1: Upon completion of the course in Bioprocess Principles graduates will be able to understand the basics of industrial bioprocess.

CO2: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO3: Understand the basic configuration of a fermentor and its ancillaries.

CO4: Learn the production of various primary and secondary metabolites.

CO5: Understand the production of biotechnological products.

Course Articulation Matrix

PO/CO	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	M	H	H												
CO2	H	M													
CO3	H	H	H	M	M	M		L	H						
CO4	H	L	L			L		L							
CO5	H	M	H	L	M			L							
16BOE X25	H	M	M	L	L	L		L	L						

L- Low, M – Moderate (Medium), H - High

16POC1Z1 **HUMAN VALUES I** Category: OC

(*Common to all branches)* L T P C

1 0 0 1

Pre-Requisites: Nil

Course Objectives:

- Essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on a correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with nature.

UNIT- I	**INTRODUCTION TO VALUE EDUCATION**	**(05)**
Introduction- Need, Basic Guidance, Content and Process for Value Education- Basic human Aspirations – Prosperity and happiness – Methods to fullfill human aspirations - Understanding and living in harmony at various levels.		
UNIT- II	**HARMONY IN THE HUMAN BEING**	**(05)**
Coexistence – Happiness and convenience – Appraisal of Physical needs – Mental and Physical health – Human relationship – Mutual Trust and Respect.		
UNIT- III	**ETHICS**	**(05)**
Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue – Caring – Sharing - honesty- Courage – Empathy – Self Confidence -Ethical Human Conduct- Basis for humanistic Education, Constitution and universal order – Competence in professional ethics – Strategy for transition from the present state to Universal human order.		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
R.R. Gaur, R. Singal, G.P. Bangaria	*"Foundation Course in Human Values and Professional Ethics", 2009*	*Excel Book Private Ltd., New Delhi.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
S. K. Chakraborty and Dabangshu Chakraborty	*Human Values and Ethics: Achieving Holistic Excellence*	*ICFAI University Press, 2006.*
A.N. Tripathy	*Human Values*	*New Age International publishers, 2003.*
M. Govindarajan, S. Natarajan and V.S. Senthil kumar	*Engineering Ethics(including human values)*	*Eastern Economy Edition, Printice Hall of India Ltd., 2004.*
E.G. Seebauer and Rober. L. Berry	*Fundamentals of Ethics for Scientists and Engineers*	*Oxford University Press, 2000.*

Course Outcomes:

Upon completion of this course the students will be able to

CO1: Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course.

CO2: See that their practice in living is not in harmony with their natural acceptance most of the time and able to refer to their natural acceptance to remove this disharmony.

CO3: Aware of their activities like understanding, desire,thought and selection and start finding their focus of attention at different moments.

CO4: Able to see that respect is right evaluation and only right evaluation leads to fulfillment in relationship.

CO5: Develop an understanding of the whole existence and interconnectedness in nature.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			M			H	H	H	L				L	L	L
CO2			M			H	H	H	L				L	L	L
CO3			M			H	H	H	L				L	L	L
CO4			M			H	H	H	L				L	L	L
CO5			M			H	H	H	L				L	L	L
16POC1Z1			M			H	H	H	L				L	L	L

L- Low, M – Moderate (Medium), H – High

16POCX02 **HUMAN VALUES AND PROFESSIONAL ETHICS** Category: OC

(*Common to all branches)* L T P C

1 0 0 1

Pre-Requisites: Nil

Course Objectives:

- Engineering Ethics and Human Values
- Social responsibility of an Engineer
- Ethical dilemma while discharging duties in Professional life.

UNIT- I	**ENGINEERING ETHICS**	**(05)**
Senses of Engineering Ethics -variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's Theory – Gilligen's Theory – Consensus and contraversy – Models of Professional roles – theories about right actions – Self interest – customs and religion – uses of ethical theories – Valuing time-cooperation-commitment.		
UNIT- II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**(05)**
Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – the challenger case study - engineers as managers – consulting engineers - Moral leadership		
UNIT- III	**SAFETY, RESPONSIBLITIES, RIGHTS AND GLOBAL ISSUES**	**(05)**
Safety and risk – assessment of safety and risk – risk benefit analysisand reducing risk – the three mile island and chernobyl case studies.– Environmental ethics – computer ethics – weapons development- Multinational corporations - engineers as expert witnesses and advisors.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Mike Martin and Roland Schinzinger	*Ethics in Engineering*	*McGraw Hill, New York,1996.*
M. Govindarajan,S. Natarajan and V.S. Senthil kumar	*Engineering Ethics (including human values)*	*Eastern Economy Edition, Printice Hall of India Ltd., 2004.*

Reference Books:

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Charles D.Fleddermann	*Engineering Ethics*	*Pearson Education, 2004.*
Edmund G Seebauer and Robert L. Berry	*Fundamentals of Ethics for Scientists and Engineers, 2001*	*Oxford University Press*
Charles E. Harris, Michael S. Protchard and Michael J. Rabins	*Engineering Ethics – Concepts and Cases*	*Thomson Learning, 2000.*
John R. Boatright	*Ethics and Conduct of Business*	*Pearson Education,2003.*

Course Outcomes:

Upon completion of this course the students will be able to

CO1: Understand and appreciate Human values, exhibit self confidence and develop good character

CO2: Sense engineering ethics, professional roles and valuing time, co-operation and commitment

CO3: Uunderstand and practise code of ethics.

CO4: Assess safety and risk and capable of doing risk benefit analysis.

CO5: Develop and exhibit moral leadership qualities in exercising Engineering Consultations without compromising envionmental, legal and ethical issues

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			M			H	H	H	L				L	L	L
CO2			M			H	H	H	L				L	L	L
CO3			M			H	H	H	L				L	L	L
CO4			M			H	H	H	L				L	L	L
CO5			M			H	H	H	L				L	L	L
16POCX02			M			H	H	H	L				L	L	L

L- Low, M – Moderate (Medium), H. – High

16POCX03 **YOGA FOR YOUTH EMPOWERMENT** Category: OC

(Common to Production and Mechanical) L T P C

1 0 0 1

Pre-Requisites: Nil

Course Objectives:

- To create awareness and the benefits of yoga and meditation.
- To study and analyze the influential factors, which affect the engineering students' healthy life.

UNIT- I	**PHYSICAL STRUCTURE AND ITS FUNCTIONS**	**(05)**
Yoga - Purpose of life, philosophy of life, Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation		
UNIT- II	**YOGASANAS**	**(05)**
Rules & Regulations – asana, pranayama, mudra, bandha		
UNIT- III	**MIND**	**(05)**
Bio magnetism& mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book
VethathiriMaharashi	*Yoga for Modern Age*
VethathiriMaharashi	*Mind*

Course Outcomes:

On completion of the course, student will be able to

CO 1: YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.

CO 2: Work skillfully and perfectly towards the excellence.

CO 3: achieve meditation practices, which strengthen the mind and increases the will power, Concentration, creativity and ultimately to transform the mind to achieve self-realization

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1						H							L		
CO 2									M					L	
CO 3							L				L		L		L
16POCX03						L	L		M		L		L	L	L

L- Low, M – Moderate (Medium), H – High

16POCX04 **BASICS OF CIVIL ENGINEERING** Category: OC

(Common to Production and Mechanical) L T P C

1 0 0 1

Pre-Requisites: Nil

Course Objectives:

- To make the students aware of basic concepts of Civil Engineering by exposing the students about the building materials and construction methods followed.

UNIT- I	**BUILDING MATERIALS**	**(07)**
Qualities of good building stone - Qualities of good brick - Cement composition, types and uses - Properties and uses of tor steel, structural steel sections, timber - Concrete - Grade of concrete - Properties of reinforced concrete.		
UNIT- II	**BUILDING CONSTRUCTION**	**(08)**
Foundation functions – Failures - Bearing capacity of soil - Different types of foundation. Masonry - Points to be observed in construction - Brick masonry – Types of bond - Stone masonry - Random rubble and Ashlar masonry. Flooring - Various types of floor finishing for Residential, Industrial buildings.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Punmia B.C	*Basic Civil Engineering*	*Lakshmi Publications, 2003*
Bhavikatti S. S	*Basic Civil Engineering*	*New Age International Publishers, 2010*

Reference Books:

1. Rangwala S.C., "Engineering Materials", Charotar Publishing House, 2014.

2. Punmia B.C., "Building Construction", Lakshmi Publications, 2008.

Course Outcomes

On completion of this course, students will be able to

CO1: Know the qualities and properties for building materials used in the field

CO2: Apply the knowledge of construction practices in real life situation in the societal context.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L		L						L					
CO2						L		L	M	M	H	L	L		L
16POCX04	H	L		L		L		L	M	M	H	L	L		L

L- Low, M – Moderate (Medium), H - High

16POCX05 **METALLOGRAPHY** Category: OC

Pre-Requisites: L T P C

1. 16PPC306 – Engineering metallurgy 1 0 0 1

Course Objectives:

- To familiarize the students in advanced knowledge of metallographic analysis of the content of the subject material science.

UNIT-I	**MICROSCOPY**	**(5)**
Metallographic techniques – specimen preparation – resolution – phase contrast – quantitative techniques.		
UNIT-II	**RADIOGRAPHY ANALYSIS**	**(10)**
X – Ray diffraction techniques – stereographic projection - determination of crystal structure, lattice parameter, phase diagram and residual stress – quantitative phase estimation - application of Scanning electron microscope, EDX. Electron probe micro analysis, scanning Tunneling Microscope (STM) and Atomic Force Microscope.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Culity B.D., Stock S.R. & Stock S	*Elements of X-ray diffraction*	*PHI, 2005.*
Goldsten I.J., Dale E., Echin N.P & Joy D.C.	*Scanning Electron Microscopy and X-ray micro analysis*	*ISBN-0306441756, Plenum Publishing Co., 2000.*

Course Outcomes:

On completion of this course, students will be able to

CO 1: employ the metallographic techniques for specimen preparation

CO 2: describe various radiographic techniques in metallography.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	H	M	L			M	M	M	H	M	M	M
CO2	H	M	H	H	M	L			M	M	M	M	M	M	M
16POCX05	H	M	H	H	M	L			M	M	M	M	M	M	M

L- Low, M – Moderate (Medium), H – High

16POCX06 DESIGN OF EXPERIMENTS USING TAGUCHI CONCEPT Category: OC

Pre-Requisites:

L	T	P	C
1	0	0	1

1. 16PBS401 Probability and Statistics
2. 16PPC504 Metrology and Computer Aided Inspection
3. 16PHS501 Total Quality Management

Course Objectives:

- To achieve optimized results by approaching various special Experimental Techniques for various design problems.

UNIT- I	**INTRODUCTION TO QUALITY BY DESIGN**	**(03)**
Introduction - goal post philosophy – Taguchi's definition of quality - Taguchi loss function - quality characteristics.		
UNIT- II	**DESIGN PROCESS**	**(03)**
Objective of engineering design - variability due to noise factors - prediction of the process average under optimum condition.		
UNIT- III	**ORTHOGONAL ARRAYS AND MATRIX EXPERIMENTS**	**(03)**
Matrix experiments - orthogonal arrays – degrees of freedom of orthogonal arrays – interaction effects - prediction of the process.		
UNIT- IV	**SIGNAL-TO-NOISE RATIO**	**(03)**
Signal-to-noise (SN) ratio for static problems - Relation ship between SN ratio and quality loss, and its applications.		
UNIT- V	**CONDUCTING AN EXPERIMENT**	**(03)**
Randomized block design – completely randomized design – two level factorial experiments - analysis of experiments.		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Philip J Rose	*Taguchi techniques for quality engineering*	*Prentice Hall, 2005.*
NicoloBelavendram	*Quality by Design, Taguchi techniques for Industrial experimentation*	*Prentice Hall, 1995.*
Montgomery D.C	*Design and Analysis of Experiments*	*5th Edition, John Wiley and Sons, NewYork., 2001*

Reference Books:

1. *Sung H Park, Robust Design and Analysis for Quality Engineering, Chapman and Hall, London, 1996.*
2. *Giani Taguchi, Elssayed A. Elsayed, Thomas C. Hsiang, Quality Engineering in Production Systems, Mc Graw Hill Book Company, 1989.*
3. *Genichi Taguchi, Subir Chowdhury and Shin Taguchi, Robust Engineering, McGraw Hill, New York, 2000.*

Course Outcomes:

On completion of this course, students will be able to

CO1: understand the quality concepts in engineering.

CO2: describe the influences of design process related with quality.

CO3: explain the concept of orthogonal array and its interaction effects.

CO4: explain about signal to noise ratio and quality loss function..

CO5: conduct experiments on randomized block and completely randomized block for optimization

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M	L								L	M	M
CO2	M	M	M	M	L								L	M	M
CO3	M	M	M	M	L								L	M	M
CO4	M	M	M	M	L								L	M	M
CO5	M	M	M	M	L								L	M	M
16POCX06	M	M	M	M	L								L	M	M

L- Low, M – Moderate (Medium), H - High

16POCX07 **ENTREPRENEURSHIP DEVELOPMENT** Category: OC

L	T	P	C
1	0	0	1

Pre-Requisites: Nil

Course Objectives:

- To familiarise the students in entrepreneurship concepts and processes.

UNIT- I	**CONCEPT OF ENTREPRENEURSHIP**	**(05)**
Definition and concept of enterprising –Types and of entrepreneur –Factors Affecting Entrepreneurial Growth. Project Identification-Methodology of project identification - short listing and zeroing on product/service - problems in project evaluation		
UNIT- II	**FINANCE AND MARKETING**	**(05)**
Need, Sources, Capital Structure, and TermLoans. Accounting principles - conventions and concepts - balance sheet - profit and loss account - accounting rate of return, payback period, Small Scale Industry duty practice. Marketing - Sales strategies.		
UNIT- III	**ASSISTANCE TO ENTREPRENEUR**	**(05)**
Small industries development in India and its concept - ancillary industries - starting a small-scale industry, Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation and Investment.		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Robert D Hisrich, Michael P Peters & Dean Shepherd	*Entrepreneurship*	*Tata McGraw Hill, 2007.*
Donald F Kuratko and Richard M Hodgetts	*Entrepreneurship*	*South-Western.*

Reference Books

1. *Vasant Desai, "The Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 2010.*
2. *Sudha G S, "Management and Entrepreneurship Development", Indus Valley Publication, 2009.*
3. *Thomas W Zimmerer and Norman M Scarborough, "Essential of Entrepreneurship and Small Business Management", Prentice Hall of India, 2009.*
4. *Marc J Dollinger, "Entrepreneurship-Strategies and Resources", Pearson Education, 2003.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe the basic concept of entrepreneurship.

CO2: Describe the financial concepts and marketing.

CO3: Describe the assistance to entrepreneur.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M					M		M	L		L	M			L
CO2	M		M						M	H	H				
CO3	M	M	L			L		M	M	M		M			
16POCX07	M	M	L			L		M	M	M	M	M			L

L- Low, M – Moderate (Medium), H - High

16POCX08 **PATENTS SYSTEMS IN ENGINEERING** Category: OC

L	T	P	C
1	0	0	1

Pre-Requisites: Nil

Course Objectives:

- To familiarise the students in patent systems and processes.

UNIT- I	**INTRODUCTION TO IPR & PATENTS**	**(05)**
Understanding of Intellectual Property Rights - IPR Regime - Legislations and Salient Features of Patent Act - Content of Indian Patent System.		
UNIT- II	**PATENT SEARCH, DRAFTING & FILING PROCEDURE IN INDIA**	**(05)**
Patent Search - Patent Drafting - Patent Filing Procedure in India - Patent Prosecution in India.		
UNIT- III	**PATENT ENFORCEMENT IN INDIA AND INTERNATIONAL PATENT SYSTEMS**	**(05)**
Enforcement of Patents - Infringement of Patents - International Patent Systems - International Treaties for Patent - Multilateral Agreements.		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books

Author Name	Title of Book	Publisher, Year Of Publication
Neeraj Pandey, KhushdeepDharni	*Intellectual Property Rights*	*PHI Learning pvt. Ltd - New Delhi*
S.R.A. Rosedar	*Intellectual Property Rights*	*LexisNexis, 1st edition, 2014.*

Course Outcomes

On completion of this course, students will be able to

CO1: Describe the basic concept of Intellectual Property Rights.

CO2: Describe the IPR filing procedure in india.

CO3: Describe the patent enforcement and international patent systems.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M					M		M	L		L	M			L
CO2	M		M						M	H	H				
CO3	M	M	L			L		M	M	M		M			
16POCX08	M	M	L			L		M	M	M	M	M			L

L- Low, M – Moderate (Medium), H - High

16POCX09 **INDUSTRIAL CASE STUDIES** Category: OC

L	T	P	C
0	0	2	1

Pre-Requisites: Nil

Course Objectives:

- The main objective of the Industrial Training is to experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process of how student's knowledge could be used in a realistic way.

The students have to undergo practical industrial training for four weeks (During Sixth Semester holidays) in recognized industrial establishments.
At the end of the training they have to submit a report with following information:

1. Profile of the Industry,
2. Product range,
3. Organization structure,
4. Plant layout,
5. Processes/Machines/Equipment/devices,
6. Personnel welfare schemes,
7. Details of the training undergone,
8. Projects undertaken during the training, if any
9. Learning points.

End Semester examination will be a Viva-Voce Examination during Seventh Semester. The assessments will be based equally on the report in the prescribed format and viva- voce examination by a committee nominated by the Head of the Department.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 30 Periods

Course Outcomes
On completion of this course, students will be able to
CO1: understand the different forms of organization, functions of management, organizational behavior, group dynamics and modern concepts in industrial management.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	H	L	M	L		L	M	L	M	L	M	M	M
16POCX09	M	M	H	L	M	L		L	M	L	M	L	M	M	M

L- Low, M – Moderate (Medium), H – High

16POCX10 **PROJECT MANAGEMENT** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To study about project integration management, project time & project cost management, project quality and risk management and project procurement.

UNIT- I	**PROJECT INTEGRATION MANAGEMENT**	**(03)**
Project Management Framework - Project Management Processes and Process Groups - Implementing Project Integration Management - Developing Project Plan.		
UNIT- II	**PROJECT TIME AND PROJECT COST MANAGEMENT**	**(03)**
Project Time Management: Mapping the activities – Project Network Diagrams (PND) - PERT, GERT, CPM. Project Cost Management: Estimating and analyzing of the Project Cost - Cost Control.		
UNIT- III	**PROJECT QUALITY MANAGEMENT**	**(03)**
Quality Vs Grade - Kaizen technology - Quality Policy - Cost / Benefit Analysis - Cause and Effect Diagram - Quality Assurance.		
UNIT- IV	**PROJECT RISK MANAGEMENT**	**(03)**
Creating Risk Management Plan - Identifying Risks - Delphi Technique - SWOT Analysis. Qualitative Risk Analysis - Probability Impact matrix. Quantitative Risk Analysis - Decision tree Analysis.		
UNIT- V	**PROJECT PROCUREMENT**	**(03)**
Maslow's hierarchy - Herzberg's Theory of motivation McGregor's Theory of X and Y - Ouchi's Theory Z - Staff Management - Project Team Management. Project Communications Management - Communication Skills - Communication Matrix.		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Joseph Phillips	*Project Management Professional Study Guide*	*McGraw-Hill, USA, 3rd edition, 2010.*
Claudia Baca, Patti Jansen	*Project Management Professional Workbook*	*Shreff Publishers*

Reference Books

1. *Ralph L. Kleim and Irwin S. Ludin, "Project Management Practitioners Handbook".*
2. *Prasanna Chandra, .Projects., Tata McGraw Hill., 4th edition, 1997.*
3. *Choudry S., .Project Management., Tata McGraw Hill., 27th edition, 2006.*
4. *Tim Pyron, .Special Edition Using Microsoft Office Project 2007", Que.*
5. *Carl Chatfield and Timothy Johnson, "Microsoft Office Project 2007 Step by Step", Microsoft Press.*
6. *Website: http://www.pmi.org*

Course Outcomes

On completion of this course, students will be able to

CO1: discuss on the framework of project management and its integration

CO2: understand the tools used in project time and cost management

CO3: discuss about various tools and techniques used in project quality and risk management

CO4: describe theories on HR management, Communication management and Project procurement

CO5: demonstrate various tasks involving in project management using Software.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L	M	L						M	M		L		L
CO2	M	L	M	L						M	M		L		L
CO3	M	M	M	L						M	M		L		L
CO4	M	M	M	L						M	M		L		L
CO5	M	M	M	L						M	M		L		L
16POCX10	M	M	M	L						M	M		L		L

L- Low, M – Moderate (Medium), H - High

16POCX11 **INDUSTRIAL SAFETY** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To introduce the safety awareness among the students.

UNIT- I	**INTRODUCTION**	**(05)**
The importance of safety and health for engineers – Safety and Health professions – Fundamental concepts and terms.		
UNIT- II	**HAZARDS AND CONTROL**	**(05)**
General principles – Structural failures, Slipping, Electrical hazards, Tools, transportation – Modes, causes and Prevention.		
UNIT- III	**SAFETY MANAGEMENT**	**(05)**
Fundamentals – Risk management and Assessment – safety plans and programs.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Roger.L. Brauer	*Safety And Health For Engineers*	*Wiley Interscience, 2006*

Course Outcomes:

On completion of this course, students will be able to

CO1: explain about the importance of safety.

CO2: describe the types of hazards and their prevention methods

CO3: explain about the guidelines for safety management

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						H	H	H	M		L		L	L	L
CO2						H	H	H	M		L		L	L	L
CO3						H	H	H	M		L		L	L	L
16POCX11						H	H	H	M		L		L	L	L

L- Low, M – Moderate (Medium), H - High

16POCX12 **SIX SIGMA** Category: OC

(Common to Production and Mechanical) L T P C

1 0 0 1

Pre-Requisites:

1. 16PPE009 – Statistical Quality Control and Reliability Engineering

Course Objectives:

- To impart knowledge on six sigma tools on projects and successful completion of projects that drive meaningful business results.

UNIT - I	**SIX SIGMA QUALITY AND STANDARDS**	**(5)**
Meaning and use of the Six Sigma approach- the underlying concept of variation- the relationships to related Quality Management approaches – Basic six sigma tools – Nature of six sigma improvements projects.		
UNIT – II	**DEFINING THE PROJECT MISSION**	**(5)**
Focus on creativity and creativity tools used in coming up with creative formulations and solutions in Six Sigma improvement projects.-Review and management of Six Sigma projects		
UNIT – III	**INTRODUCTION TO STATISTICS AND EXCEL**	**(5)**
Statistical techniques for summarizing data and extensive use of Microsoft Excel-Statistical Process control.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Joseph A De Feo, William W BearnardJuran Institute	*Six Sigma Break Through and Beyond*	*Tata McGraw Hill, New Delhi, 2004*
Richard B Chase F Robert Jacobs and Nicholas J Aquilano	*Operations Management for Competitive Advantage*	*McGraw Hill Inc., New York, Tenth Edition, 2003*
Poka - Yoke	*Improving Product Quality by Preventing Defects*	*Productivity Press, Portland, Oregon, 1993*

Reference Books:

1. *George Eckes "Six Sigma for Everyone, John Wiley & Sons", 2003.*
2. *J M Juran ,F.M.Gyna&R.S.Bingham , "Quality control Hand book , McGraw Hill book co,1979.*
3. *Rath, Strong Staff "Six Sigma Leadership Handbook , John Wiley & sons" , 2003.*
4. *Mikel J Harry "Six Simga: The Break through Management Strategy Revolutionizing the World's top Corporations", 2000.*
5. *Robert O Slater "Management Insights and Leadership Secrets of the Legendary CEO", ,*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the six sigma approach and basic six sigma tools.

CO2: use the creativity tools.

CO3: employ the statistical techniques for summarizing datas.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	H	M	L			L	M	M	L	M	M	M
CO2	H	M	M	H	M	L			L	M	M	M	M	M	M
CO3	H	H	M	H	M	L			L	M	M	L	M	M	M
16POCX12	H	H	M	H	M	L			L	M	M	L	M	M	M

L- Low, M – Moderate (Medium), H - High

16POCX13 **PROFESSIONAL SKILLS** Category: OC

L	T	P	C
1	0	0	1

Pre-Requisites: Nil

Course Objectives:

- To introduce the fundamental economic principles necessary for production managers

UNIT- I	**SELF MANAGEMENT AND ATTITUDES**	**(05)**
Self Concept, Stress management, Positive attitude, Influential Skills, Initiative, Empathy, Social Etiquette		
UNIT- II	**LEADERSHIP SKILLS**	**(05)**
Empowerment, Planning, Establishing Credibility, Vision & direction, Supervision, Mentoring, Decision making, Creativity, Flexibility, Team problem solving		
UNIT- III	**TEAM WORK**	**(05)**
Inter team cooperation, Intra team cooperation, Diversity, Productivity, Goal Setting and action		

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year Of Publication
Rao M S	*Soft Skills –Enhancing Employability-Connecting Campus with Corporate*	*IK International Publishing House, New Delhi, 2010*

Reference Books:

1.Simon Sweeney, "English for Business Communication", Cambridge University Press, New Delhi, 2012

Course Outcomes:

On completion of this course, students will be able to

CO1: manage themselves and improve their attitude.
CO2: develop the leadership skills.
CO3: work in a team environment.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									M	H	H	H	L	L	L
CO2									M	H	H	H	L	L	L
CO3									M	H	H	H	L	L	L
16POEX13									M	H	H	H	L	L	L

L- Low, M – Moderate (Medium), H – High

16POCX14 **SOLAR ENERGY SYSTEMS** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To familiarize the importance of solar energy and methods of harnessing solar energy.

UNIT- I	**SOLAR THERMAL ENERGY COLLECTORS AND STORAGE DEVICES**	**(07)**
A review of energy related environmental problems, introduction to solar energy, Devices for thermal collections - Liquid flat plate collector – Solar Air heater – Parabolic concentrating collector – Fresnel reflector - Power tower system – Thermal Storage devices – Latent heat and sensible heat storage.		
UNIT- II	**THERMAL APPLICATIONS**	**(05)**
Water heating – Space heating – Space cooling and refrigeration – Distillation Drying – Cooking - Solar thermal power plant-Low temperature – medium temperature and high temperature power plant.		
UNIT- III	**SOLAR PHOTO VOLTAIC SYSTEM**	**(03)**
Solar cell – basic principle - Solar Photo voltaic system for power generation – off – grid and grid connected system – other PV application.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
S.P. Sukhatme	*Solar Energy: Principles of Thermal Collection and Storage*	*Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.*

Reference Books:

1. *G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.*
2. *G.N. Tiwari, solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe the characteristics of Solar thermal and Solar Photovoltaic Systems.

CO2: explain various solar thermal and Photo voltaic applications.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L					H					M	M		
CO2	L	L					H					M	M		
16POCX14	L	L					H					M	M		

L- Low, M – Moderate (Medium), H – High

16POCX15 **WIND ENERGY SYSTEMS** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To develop adequate knowledge about wind energy conversion systems.

UNIT- I	**WIND ENERGY PRINCIPLES**	**(04)**
Principles of wind Energy Conversion- Nature of wind – Power in the wind – Forces on the wind – wind energy conversion – wind data and wind energy estimation - Site Selection Considerations.		
UNIT- II	**WIND ENERGY CONVERSION SYSTEM**	**(06)**
Wind Energy Conversion system- Basic components of WECS – Classification - Advantages and Disadvantages of WECS- Types of wind energy collectors – horizontal axis machines – design considerations – vertical axis machines – performance of wind machines.		
UNIT- III	**WIND ENERGY APPLICATIONS**	**(05)**
Applications of WECS – Pumping – wind assisted gas turbine generators – direct heat applications – Electricity generation -Interconnected System-Environmental Aspects.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
G.D. Rai	*Non Conventional Energy Sources*	*Khanna Publishers, New Delhi, 1999.*

Reference Books:

1. *Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.*
2. *L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.*

Course Outcomes:

On completion of this course, students will be able to

CO1: Describe the various types of Wind Energy Conversion System (WECS) and its components.

CO2: Select suitable site for erecting Wind Energy Conversion System considering environmental aspects.

CO3: Explain various applications of wind energy conversion system.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M												M		
CO2	L	H	M	M		M	H								H
CO3	M						M								M
16POCX15	M	H	M	M		M	M						M		M

L- Low, M – Moderate (Medium), H - High

16POCX16 **REFRIGERATION SYSTEMS** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To develop adequate knowledge about refrigeration systems.

UNIT- I	**REFRIGERATION CYCLES AND REFRIGERANTS**	**(08)**
Air refrigeration cycles – reversed Carnot cycle, Bell Coleman cycle, simple vapour compression refrigeration cycle, compound compression refrigeration cycles, and cascade refrigeration cycles.		
UNIT- II	**VAPOUR ABSORPTION AND OTHER SYSTEMS**	**(07)**
Ammonia – water system, Lithium Bromide – water system - Electrolux refrigeration system, Steam jet refrigeration and solar refrigeration systems. Refrigerants – properties and classification– eco friendly refrigerants.		

Contact Periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Arora C.P	*Refrigeration and Air Conditioning*	*Tata McGraw Hill Publishing Company Limited, 3rd Edition, NewDelhi, 2009*

Reference Books:

1. *Roy J Dossat, Principle of Refrigeration, Wiley Eastern Limited, Fifth Edition 2001.*

Course Outcomes:

On completion of this course, students will be able to

CO1: describe various refrigeration cycles.

CO2: explain various refrigeration systems operated using heat energy.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M		L									L	M		
CO2	L		L										M		
16POCX16	M		L									L	M		

L- Low, M – Moderate (Medium), H - High

16POCX17 **AIR CONDITIONING SYSTEMS** Category: OC

L T P C

Pre-Requisites: Nil 1 0 0 1

Course Objectives:

- To develop adequate knowledge about air conditioning systems.

UNIT- I	**AIR DISTRIBUTION SYSTEMS**	**(07)**
Air distribution systems – study of different types of duct systems, duct insulation, air purity – air cleaning methods.		
UNIT- II	**CONDITIONING AND COOLING LOAD**	**(08)**
Psychrometry, psychrometer, psychometric processes, moist air behaviour, effective temperatures, sensible heat factor ratio and cooling load estimation for an air conditioned space.		

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods

Text Books:

Author Name	Title of Book	Publisher, Year of Publication
Arora C.P	*Refrigeration and Air Conditioning*	*Tata McGraw Hill Publishing Company Limited, 3rd Edition, NewDelhi, 2009*

Reference Books:

1. *Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Limited, 2004.*

Course Outcomes:

On completion of this course, students will be able to

CO1: explain the air distribution systems and components.

CO2: estimate cooling load for air conditioning.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M											L	M		
CO2	L		L			L									
16POCX17	M		L			L						L	M		

L- Low, M – Moderate (Medium), H - High