SCHEME AND SYLLABI FOR

THIRD & FOURTH SEMESTER

OF

BACHELOR OF TECHNOLOGY IN

PRODUCTION ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

University of Calicut

PRODUCTION ENGINEERING

3rd Semester

Code	Subject	Hours/week			Marks		Sem- end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-end		
EN09 301	Engineering Mathematics III	3	1	-	30	70	3	4
EN09 302	Humanities and Social Sciences	2	1	-	30	70	3	3
PE09 303	Electrical Drives and Automation	4	1	-	30	70	3	5
PE09 304	Mechanics of Solids	3	1	-	30	70	3	4
PE09 305	Metallurgy and Material Science	3	1	-	30	70	3	4
PE09 306	Machine Tool Technology	3	1	-	30	70	3	4
PE09 307(P)	*Production Engineering Drawing*	-	-	3	50	50	3	2
PE09 308(P)	*Machine Tool Lab-I*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

EN09 301: Mathematics III

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Module I (14 hours)
Linear Algebra (Proofs not required)
Vector spaces – Linear dependence and independence and their computation – Bases and dimensions – Subspaces – Inner product spaces – Gram – Schmidt orthogonalisation process- Linear transformation – Elementary properties of linear transformations – matrix of linear transformation. (Proofs of theorems omitted)

Module II (14 hours)
Fourier integral theorem (proof not required) – Fourier sine and cosine integral representation – Fourier transforms – Fourier sine and cosine transforms – Properties of Fourier transforms – Singularity functions and their Fourier transforms

Module III (13 hours)
Probability Distributions
Random variables – Mean and variance of probability distributions – Binomial and Poisson distributions – Poisson approximation to binomial distribution – Hypergeometric and geometric distributions – Probability densities – Normal, uniform and gamma distributions

Module IV (13 hours)
Theory of Inference
Population and samples – Sampling distributions of mean and variance – Point and interval estimations – Confidence intervals for mean and variance – Tests of hypotheses – Hypotheses concerning one mean, two means, one variance and two variances – Test of goodness of fit.

Text Books
Module I
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley & Sons Inc.
Sections: 12. 3, 12.4, 12.5, 12.6, 12.7, 12.9
Module II
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley & Sons Inc.
Sections: 13.1,13.2,13.3,13.4,14.4,15.1,15.2,15.3,15.4
Module III
Bernaed Kolman, David R Hill, Introductory Linear Algebra, An Applied First Course, Pearson Education
Sections: 6.1, 6.2, 6.3, 6.4, 6.7,6.8, Appendix B 1
Module IV
Wylie C R & L C Barrett, Advanced Engineering Mathematics, Mc Graw Hill
Sections: 9.1,9.3, 9.5

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

EN09 302: Humanities and Social Sciences

(Common to all)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Module I(9 hours)

Introduction to English usage and grammar

Review of grammar - affixes, prefixes, suffixes, participles and gerunds - transformation of sentences - commonly misspelt words - correction of mistakes - punctuation - idioms - style - vocabulary building

Reading comprehension -Exposure to a variety of reading materials, articles, essays, graphic representation, journalistic articles, etc.

Writing comprehension-Skills to express ideas in sentences, paragraphs and essays

Module II (9 hours)

Technical communication and report writing

Need, importance and characteristics of technical communication – correspondence on technical matters-aspects of technical description of machinery, equipment and processes - giving instructions in an industrial situation - note taking and note making - correspondence on technical topics - different types of technical reports

Module III (9 hours)

History of science and technology

Science and technology in the primitive society – the development of human civilization from primitive to modern society- impact of sciences and technology on societies – Cultural and industrial revolutions - the rise and development of early Indian science – contribution of Indian scientist-JC Bose, CV Raman, Visweswaraya-Ramanujam and Bhabha- Gandhian concepts- recent advances in Indian science

Module IV (9 hours)

Humanities in a technological age

Importance of humanities to technology, education and society - relation of career interests of engineers to humanities - relevance of a scientific temper - science, society and culture

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

*PART A: Short answer questions (one/two sentences)5 x 2 marks=10 marks*All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.*PART B:Analytical/Problem solving questions4 x 5 marks=20 marks*Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.*PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks* Two questions from each module with choice to answer one question.*Maximum Total Marks: 70*

PE09 303: Electrical Drives and Automation

Teaching scheme **Credits:** 5

4 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of Electric drives*
- *To give concepts on microprocessors, PLC automation*
- *To give awareness on specific applications in industries*

Module I (18 Hours)

D.C Machines and Transformers:

Transformers: Single Phase transformers – Construction - Principle of operation - e.m.f.equation – equivalent circuit – phasor diagram - O.C. and S.C test – efficiency – voltage regulation

D.C. machines: D.C. Generators – construction details – e.m.f.equation – different types – magnetization and load characteristics – D.C. motors – Principle of operation – torque and speed equations – back e.m.f. – Performance characteristics and applications of shunt, series and compound motors.

Module II (18 hours)

Synchronous and Induction machines – Only the basic concepts and equations

Synchronous machines – construction details – types – rotating magnetic field (concepts only) – chording factor and distribution factor (no derivation) - e.m.f. equation - Synchronous motors – principle of operation.

Induction motor – Construction – types - principle of operation – slip - torque equation – torque slip characteristics.

Single phase induction motors – double field revolving theory - capacitor start motors – capacitor start and run motors – applications.

Module III (18 hours)

Digital systems and Microprocessors

Review on Digital circuits (gates, flip flops) – Half adder & full adder - Asynchronous and synchronous counter – 555 Timer IC – applications.

Introduction to Microprocessor – block diagram of microcomputer – CPU – architecture of Intel 8085 – Memory mapping concepts – memory decoding - Execution of instruction and timing considerations – Programming of microprocessors instruction types – addressing modes – Intel 8085 instruction set – simple assembly language programs and examples – Microprocessor applications – Microprocessor based temperature control – Microprocessor based speed control (Block diagram approach only).

Module IV (18 hours)

Industrial drives and control

Introduction to Electric drives – control schemes – Speed control – Components of Electric drives: Motors, Power electronic controllers (Block diagram approach)

Industrial applications of electric drives: Synchronous motor drives, Induction motor drives, D C motor drives. Selection of drives for general factory – Cement mill, Rolling mill, Paper mill, Coal mines, textile mill, machine tool drives.

PLC automation : Introduction – Overview of PLC systems – Theory of operation – Ladder logic – Programming concepts – simple program – Case study of simple PLC system

Text Books

Module I & II

D.P. Kothari, I.J.Nagarath, *Electric Machines* ,Tata Mcgraw Hill.

J.B.Gupta, *Theory and Performance of Electrical machines*, S.K.Kataria and Sons

Module III

B.RAM,*Microporocessors*, Dhanpat Rai & Sons

Module IV

N.K.De, P.E.Sen, *Electric drives*, Prentice hall India

W.Bolton , *Programmable Logic Controllers* , Academic Press.

Reference Books

H.Cotton, *Electrical technology*, ELBS

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

*PART A: Short answer questions (one/two sentences)5 x 2 marks=10 marks*All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.*PART B:Analytical/Problem solving questions4 x 5 marks=20 marks*Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.*PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks* Two questions from each module with choice to answer one question.*Maximum Total Marks: 70*

PE09 304: Mechanics of Solids

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To acquaint with the basic concepts of stress and deformation in solids.*
- *To practise the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.*

Module I (14 hours)

Simple Stress and Strain: Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Simple stresses – stresses due to normal, shear and bearing loads – strength design of simple members. Axial and shear strains –

Material behaviour – uniaxial tension test – stress-strain diagrams – concepts of orthotropy, anisotropy and inelastic behaviour – Hooke's law for linearly elastic isotropic material under axial and shear deformation – deformation in axially loaded bars – thermal effects – statically indeterminate structures – principle of superposition. Elastic strain energy for uniaxial stress. Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial and triaxial deformations – Bulk modulus - Relations between elastic constants.

Module II (14 hours)

Torsion: Torsion theory of elastic circular bars – assumptions and limitations – polar modulus - torsional rigidity – economic cross-sections – statically indeterminate problems – design for torsional load (shaft and flanged bolt coupling) – torsion of inelastic circular bars (introduction only).

Axial force, shear force and bending moment: Diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam – differential relations between load, shear force and bending moment - shear force and bending moment diagrams by direct and summation approach - use of singularity functions – elastic curve – point of inflection.

Module III (13 hours)

Stresses in beams: Pure bending – flexure formula for beams – assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength.

Shearing stress formula for beams – assumptions and limitations - shear flow – design for flexure and shear (reinforced beams, fliched beams, etc.) – inelastic bending (introduction only).

Deflection of beams: Moment-curvature relation – assumptions and limitations - double integration method - singularity functions – Macculays method – superposition techniques – moment area method and conjugate beam ideas for simple cases – elementary treatment of statically indeterminate beams.

Module IV (13 hours)

Transformation of stress and strains: Plane state of stress - equations of transformation - principal stresses. Plane state of strain – analogy between stress and strain transformation - Mohr's circles of stress and strain – strain rosettes.

Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - kern of a section (rectangular and circular section) - combined bending and twisting loads.

Theory of columns: Buckling theory –Euler's formula for long columns – assumptions and limitations – effect of end conditions - slenderness ratio – Rankine's formula for intermediate columns – Eccentric loading of columns – secant formula.

Text Books

1. E. P. Popov, *Engineering Mechanics of Solids*, Prentice Hall of India
2. A. Pytel, F. L. Singer, *Strength of Materials*, Harper & Row Publishers, New York
3. P. N. Singh, P. K. Jha, *Elementary Mechanics of Solids*, Wiley Eastern Limited, New Delhi

Reference Books

1. S. P. Timoshenko, D. H. Young, *Elements of Strength of Materials*, McGraw Hill
2. I. H. Shames, *Introduction to Solid Mechanics*, Prentice Hall of India
3. F. Beer, E. R. Johnston, J. T. DeWolf, *Mechanics of Materials*, McGraw Hill
4. S. H. Crandal, N. C. Dhal, T. J. Lardner, An *Introduction to the Mechanics of Solids*, Mc-Graw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, etc.
10% - Regularity in the class

University Examination Pattern

*PART A: Short answer questions (one/two sentences)5 x 2 marks=10 marks*All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.*PART B:Analytical/Problem solving questions4 x 5 marks=20 marks*Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.*PART C: Descriptive/Analytical/Problem solving questions 4 x 10 marks=40 marks* Two questions from each module with choice to answer one question.*Maximum Total Marks: 70*

PE09 305: Metallurgy and Material Science

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide basic knowledge in metallurgical aspects of material and its properties*
- *To give an exposure on materials and their structures*
- *To create general awareness regarding instruments and techniques used for material characterization*

Module 1 (14 hours)
History of materials, Metallic Materials, Non metallic Materials, Composites- Structure of solids- Crystal Structure, Metallic crystal structures, Directions & Planes
Crystallization of pure metals- Nuclei Formation, Crystal growth, Grain size.
Crystal defects- Point defects, Line defects, planar defects

Module II (14 hours)
Alloys & phase diagrams- Solid solutions-Phase rule-Lever rule-Equilibrium Diagram of Binary system-Eutectic, Peritectic & Eutectoid reactions-Iron carbon diagrams

Module III (13 hours)
Heat treatment of steels- Isothermal transformation – TTT diagrams-CCT diagrams, Annealing Normalizing, Hardening, Tempering, Austempering, Martempering, Carburizing, Nitriding etc., Diffusion mechanisms, strengthening mechanisms

Module IV (13 hours)
Structure determination- study of microstructure, surface preparation-specimen preparation-Metallurgical microscope-Mechanical testing of materials-Hardness test, Impact test, Fatigue test, Creep test.

Text Books
1. R Sreenivasan, *Engineering materials & metallurgy*, Tata Mc GrawHill Publishers

References
1. William D. Callister, *Material Science and Engineering*, John Wiley and sons Inc
2. George.E.Diter, *Mechanical Metallurgy*, Mc Graw Hill
3. R.A.Higgins, *Engineering Metallurgy applied to physical Metallurgy*, VIVA (Low Priced)
4. Sir.Allan Cottrel, *An Introduction to Metallurgy*, University Press

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, ec.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 306: Machine Tool Technology

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart basic knowledge about different machine tools*

Module I (14 hours)

Lathe - Different classifications - constructional features - driving mechanisms - tool and work holding devices - operations - speed, feed, depth of cut and machining time calculations – specifications - Capstan, turret and automatic lathes - constructional features - tool layout - tool and work holding devices – operations

Module II (14 hours)

Abrasives and abrasive tools - types of abrasives and their properties - manufacture of grinding wheels - types of bond, grit, grade, structure - nomenclature of a grinding wheel - selection of a grinding wheel, dressing truing and balancing of grinding wheels - Grinding machines - classification of grinding machines - constructional features - tool and work holding devices - operations - cylindrical, surface, centreless, thread, form, tool and cutter grinding – specifications - Surface finishing lapping, honing, super finishing -equipments - tolerance and finish, buffing - applications.

Module III (13 hours)

Milling, Drilling and boring machines - Classification - constructional features - driving mechanisms - tool and work holding devices - types of tools - operations – specifications - Gear generation methods - Gear shaping, gear hobbing, gear shaving, gear grinding, gear lapping - bevel gear generators

Module IV (13 hours)

Shaper, planer, slotter and broaching machines - Different types and their field of application - constructional features - driving mechanisms - tools used - tool and work holding devices - operations – specifications

Text Books

1. Hajra Choudhary,*Elements of workshop technology, Vol. II,* Media Promoters & Publications
2. Chapman *Workshop technology*, Vol. II, III, ELBS
3. P.N. Rao,*Manufacturing Technology-Volume II,*Tata McGraw Hill

Reference Books

Lindberg, *Processes and materials for manufacture*, Prentice Hall.
ASME Tool Engineering Handbook
H.M.T, *Production Technology*, Tata McGraw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 307(P): Production Engineering Drawing

Teaching scheme **Credits:** 2
3 Hours drawing per week

Objectives

- *To impart the basic concepts of production drawing*
- *To develop understanding about how to draw a machine assembly*
- *To help the students how to translate design concepts to drawing*

Module I (12 hours)

Sketching:-

Preparation of freehand, dimensioned sketches of the following. Hexagonal bolt and nut with washer - Square headed bolt - Common types of bolts- various types of nuts for locking - locking of bolt head - foundation bolts - various types of screw heads - studs - various types of keys - pipe joints and fittings

Module II (12 hours)

Joints: cotter, knuckle, spigot and socket, flanged coupling, and universal coupling, muff coupling. Preparation of drawings

Bearings. : Footstep - Plummer block, swivel, self-aligning ball bearing, and stuffing box.

Valves - simple stop valve and non-return valve.

Module III (12 hours)

Production machines and jigs.

Lathe tailstock, chuck, tool post, bench vice and machine swivel vices, and jigs for milling and drilling, drill holder.

Text Books

1. P.S.Gill, Text *Book of Machine drawing*, S.K. Kataria Pub.
2. P .I. Varghese, *Machine Drawing*, VIP Publishers, Thrissur
3. K .C John, *Machine Drawing*, Jet Publications, Thrissur

Reference Books

1. N.D.Bhatt, *Machine drawing*, Charotra Pub.
2. Laxmi narayana, *Machine drawing*,
3. N.Sidheswar, *Machine drawing*, Tata McGraw Hill

Internal Continuous Assessment *(Maximum Marks-50)*

60%- Minimum of 3 sheets from Module I, 4 sheets from Module II and III
30%- Test/s
10%- Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 308: Machine Tool Lab-I

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To develop the machining skills*
- *To have clear understanding of working of machine tools*
- *To have an idea about the difficulty and work content in machining operations*

1. Study of different types of lathes - machine specifications - process capability – centre – capstan - turret and automatic lathes and their accessories – chucks – faceplate - steady rest - follower rest - tool post -centre collets
2. Selection of cutting parameters - speed, feed and depth of cut based on work - tool combination - coolant types.
3. Exercise on plain - step, taper turning and eccentric turning.
4. Screw cutting - external threads – multi start thread cutting.
5. Inspection and measuring of machined lathe components using vernier caliper – micrometer - thread plug and ring gauges - dial indicators and surface finish measuring instruments.
6. Turret lathe and copying lathe operation/ demonstration.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

4th Semester

Code	Subject	Hours/week			Marks		Sem- end duration- hours	Credits
		L	T	P/D	Inte- rnal	Sem- end		
EN09 401(A)	Engineering Mathematics IV	3	1	-	30	70	3	4
EN09 402	Environmental Science	2	1	-	30	70	3	3
PE09 403	Theory of Machines	4	1	-	30	70	3	5
PE09 404	Fluid Mechanics and Machinery	3	1	-	30	70	3	4
PE09 405	Design of Machine Elements	3	1	-	30	70	3	4
PE09 406	Thermal Engineering	3	1	-	30	70	3	4
PE09 407(P)	*Electrical and Electronics Lab*	-	-	3	50	50	3	2
PE09 408(P)	*Mechanical Engineering Lab*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

EN09 401 A ENGINEERING MATHEMATICS IV

(Common for Mechanical, Civil, Production, Chemical, IT)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

Probability Distributions - Random variables – Mean and Variance of probability distributions – Binomial Distribution – Poisson Distribution – Poisson approximation to Binomial distribution – hyper Geometric Distribution – Geometric Distribution – Probability densities –Normal Distribution – Uniform Distribution – Gamma Distribution.

Module II (14 hours)

Theory of Inference - Population and Samples – Sampling Distribution – Sampling distribution of Mean and Variance – Interval Estimation – Confidence interval for Mean and Variance – Testing of Hypotheses – Hypotheses concerning one mean – Hypotheses concerning two means – hypotheses concerning one variance – Hypotheses concerning two variances – Test of Goodness of fit.

Module III (13hours)

Series Solutions of Differential Equations - Power series method for solving ordinary differential equations – Legendre's equation – Legendre polynomials – Rodrigue's formula – Generating functions – Relation between Legendre polynomials – Orthogonality property of Legendre polynomials (Proof not required) – Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – Generating functions – Relation between Bessel functions – Orthogonality property of Bessel functions (Proof not required).

Module IV (13 hours)

Partial Differential Equations – Introduction – Solutions of equations of the form F(p,q) =0 ; F(x,p,q) =0 ; F(y,p,q) =0 ; F(z,p,q) =0 ; F1(x,q) = F2(y,q) ; Clairaut's form, z = px + qv + F(p,q) ; Legrange's form, Pp + Qq = R – Classification of Linear PDE's – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables – D'Alembert's solution of one dimensional wave equation.

Text Books

1. Ervin Kreyszig, *Advanced Engineering Mathematics* (8th Edition) John Wiley & Sons

Reference Books

1. C.R.Wiley & L.C.Barrett, Advanced Engineering Mathematics (Sixth Edition), Mc-Graw Hill
2. Churchil R.V. Brown J W & Verhey R F, Complex variables and Applicaions, Mc-Graw Hill
3. Pipes L.A. & Harvill L.R., Applied mathematics for Engineers and Physicists, Mc-Graw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

EN09 402: Environmental Science

(Common for all branches)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the problems of pollution, loss of forest, solid waste disposal, de-gradation of environment, loss of biodiversity and other environmental issues and create awareness among the students to address these issues and conserve the en-vironment in a better way.*

Module I (8 hours)

The Multidisciplinary nature of environmental science, Definition-scope and importance-need for public awareness. Natural resources, Renewable and non-renewable resources:
Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people.- water resources: Use and over utilization of surface and ground water, floods ,drought ,conflicts over water, dams-benefits and problems.- Mineral resources: Use and exploitation,environmental effects of extracting and using mineral resources, case studies.- Food resources: World food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging,salinity,case studies.-Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, Land resources: Land as a resource, land degradation, man induced land slides, soil erosion and desertification.

Module II (8 hours)

Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem –Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans , estuaries)
Biodiversity and its consideration
Introduction- Definition: genetic , species and ecosystem diversity-Biogeographical; classification of India –value of biodiversity: consumptive use, productive use, social ethical , aesthetic and option values Biodiversity at Global, national , and local level-India at mega – diversity nation- Hot spot of biodiversity-Threats to biodiversity: habitat loss, poaching of wild life, man , wild life conflicts –Endangered and endemic species of India-Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Module III (10 hours)

Environmental pollution
Definition-Causes, effects and control measures of Air pollution-m Water pollution –soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste management: Causes, effects and control measures of urban and industrial wastes-Role of an individual in prevention of pollution-pollution case studies-Disaster management: floods, earth quake, cyclone and landslides-Environmental impact assessment

Module IV (10 hours)

Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation, rain water harvesting, water shed management-case studies-Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Waste land reclamation-Consumerism and waste products-Reduce, reuse and recycling of products-Value education.

Text Books

1. Clark,R.S.Marine pollution,Clanderson Press Oxford.
2. Mhaskar A. K. Matter Hazrdous, Techno-science Publications.
3. Miller T. G. Jr., Environmental Science, Wadsworth Publishing Co.
4. Townsend C., Harper J, Michael Begon, Essential of Ecology, Blackwell Science
5. Trivedi R. K., Goel P. K., Introduction to Air Pollution, Techno-Science Publications.

Reference Books.

1. Raghavan Nambiar,K Text book of Environmental Studies,Nalpat Publishers Kochi
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, Email: mapin@icenet.net
3. Cunningham, W.P., Cooper, T.H., Gorhani, E & Hepworth, M.T. 2001Environmental encyclo-pedia Jaico publ. House Mumbai 1196p
4. Down to Earth, Centre for Science and Environment
5. Hawkins, R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bom-bay
6. Mckinney, M.L. & School, R.M. 1996. Environmental Science system & Solutions, Web en-hanced edition, 639p.
7. Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders Co. USA, 574p
8. Rao, M.N. & Datta, A.K 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd., 345p
9. Survey of the Environment, The Hindu Magazine
10. Wagner.K.D. 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as Report of field work, literature survey, seminar etc.
10% - Regularity in the class

Note: Field work can be Visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources , management of wastes etc.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

PE09 403: Theory of Machines

Teaching scheme **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objectives

- *The student shall learn to conduct the kinematic analysis of machinery*
- *The paper exposes the student to various kinds of mechanisms used in machines*
- *This paper should serve as a primer for learning dynamic analysis of machinery*

Module I (18 hours)
Introduction- definition and explanations of link - kinematic pair - mechanism and machine - Kinematic chains – classification - Inversions of four bar - single slider and double slider crank chains - Slotted lever and Whitworth quick return mechanisms – Mechanisms :– Pantograph - Exact and approximate straight-line mechanisms.
Kinematics - Velocity and acceleration in mechanisms - graphical solution - Corioli's component of acceleration – instantaneous centres – Kennedy's theorem – velocity analysis using instantaneous centres

Module II (18 hours)
Toothed gearing - Law of gearing - Cycloidal and involute profiles - gear terminology and standard proportions - length of arc of contact - path of contact and contact ratio - Interference and number of teeth to avoid interference - Gear trains - simple, compound, epicyclic and reverted gear trains - Gear ratio calculations.

Module III (18 hours)
Cams - classification of cams and followers - graphical determination of profiles for different followers and different types of motion
Belt and rope drives – open and crossed belt drives- velocity ratio- length of belt-ratio of centres-power transmitted – centrifugal tension – initial tension and creep

Module IV (18 hours)
Vibration - kinematics of vibratory motion - vibration systems - vibration systems having single degree of freedom - undamped free vibration - forced vibration without damping - transverse vibrations of shafts - Dunkerly's method - energy method - critical or whirling speeds - torsional vibrations.
Balancing – Static and dynamic balancing – balancing of several masses in a plane - balancing of masses rotating in several transverse planes- balancing machines.

Text Book

1. 1. S S Rattan, *Theory of Machines*, Tata McGraw Hill

Reference Books

1. J E Shigliey, *Kinematic Analysis of Mechanism*, McGraw Hill
2. P L Ballaney, *Theory of Machines*, Khanna Publishers
3. R K Bansal, *Theory of Machines*, Dhanpat Rai PublicaitonsReference Books

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 404: Fluid Mechanics and Machinery

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To develop understanding about the basic principles, concepts, mathematical and analytical tools of Fluid Mechanics.*
- *To develop understanding about the construction, working principle and characteristics of Hydraulic Machines.*

Module I (14 hours)

Definitions and properties of fluids: – Density, gas laws, equations of state, viscosity, vapour pressure, compressibility, surface tension and capillarity etc.

Fluid pressure and its measurement: - intensity of pressure, Pascal's law, Variation of pressure in static fluid:- compressible and incompressible fluids, pressure head – manometers

Fluid statics: - hydrostatic forces on submerged surfaces, buoyancy and floatation, Archimedes principle, metacentre, stability of submerged and floating bodies.

Module II (14 hours)

Types of flow – stream line, path line, streak line-continuity equation- Bernoulli's theorem for the flow of incompressible fluids-

Flow through pipes – laminar and turbulent flow- critical Reynolds number- Hagen Poiseuille Law, development of boundary layer in pipes-pipe losses

Fluid flow measurements: - pitot tube, venturimeter, orifice meter, nozzle meter

Module III (13 hours)

Dimensional analysis - Physical dimensions - dimensional homogeneity - Buckingham's theorem - geometric, kinematic and dynamic similarities - theory of models

Pumps :- reciprocating pumps - principle of working, work done, effect of acceleration, frictional resistance, separation, air vessel etc.

Hydraulic devices - Hydraulic ram, accumulators, and intensifier - principles of working, gear pumps

Module IV (13 hours)

Impact of jets: - force exerted by fluid jet on (i) stationary curved vane (ii) moving curved vane.

Turbines - classification - reaction and impulse turbines - Pelton wheel, Francis, Kaplan, turbines etc.

Centrifugal pumps - work done by the impeller, - head and efficiency - specific speed - testing of pumps. (Simple problems)

Text Books

1. Modi P.N., Seth S.M, *Hydraulics and Fluid Mechanics*, Standard Book House.
2. D S Kumar, *Fluid Mechanics and Fluid Power Engineering*, S K Kataria & Sons Pub.

Reference Books

1. Daugherty and Franzini - *Fluid mechanics with engineering applications*, McGraw Hill
2. Massey - *Mechanics of fluids*,-ELBS
3. Dr.Jagdish Lal. - *Hydraulic machinery*, Metropolitan book House Co.
4. Kumar K.L., *Engineering Fluid Mechanics*, Eurasia Publications Limited, NewDelhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 405: Design of Machine Elements

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To acquaint the students with the analytical and mathematical tools of mechanical design.*
- *To familiarise the students with practical consideration used for the design and selection of the machine components*

Module I (14 hours)

Principles of mechanical design - estimation of design load - design for steady, fluctuating and dynamic stresses - effects of stress concentration - consideration of creep and thermal stresses in design - influence of production processes in design - tolerances and fits per I.S specifications - principles of standardization - selection of materials - considerations like wear environment - human and aesthetic aspects.

Module II (14 hours)

Welded joints - stresses welded joints - strength of welded joints - fatigue loading of welded joints - design of bolts and screws.

Module III (16 hours)

Mechanical springs - design of helical springs - helical torsion spring - critical frequency of helical springs - energy storage capacity - common types of leaf springs - shafts - stresses in shafts - equivalent twisting and bending moments - effect of keyways - transmission shafts - determination of shaft size for strength - design of shafts for deflection - critical speeds for shafts - operating speeds - shafts subjected to steady and alternating loads.

Module IV (10 hours)

Couplings - rigid and flexible coupling - common types of keys, pins and retainers and their applications

The following data books may be permitted for the examination

1. Prof. Narayana Iyengar & Prof. Lingiah, *Design Data bookVol 1 &2*
2. *Design Data book of PSG College of Technology*

Text Books

1. Bhandari V.B., *Design of Machine Elements*, Tata McGraw Hill publishers
2. Shigly J.E., *Mechanical Engineering Design*, McGraw Hill, International student edition

Reference Books

1. Doughter & Valance, *Design of Machine Elements*, McGraw Hill publishers
2. Johnson, *Optimum Design of Mechanical Elements*, John Wiley

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 406: Thermal Engineering

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To acquaint the students with the fundamental concepts of Thermodynamics and Heat Transfer*
- *To equip the students to analyse and interpret various thermodynamic cycles and heat energy transfer systems*

Module I (14hours)

Introduction concept of thermodynamic property and state – intensive and extensive properties – control volume approach – laws of thermodynamics – zero'th law and temperature – energy transfer as work – first law of thermodynamics and internal energy — second law of thermodynamics – reversibility and availability – entropy as a property – enthalpy – absolute entropy and third law of thermodynamics (problems of elementary nature)

Module II (14 hours)

Working substance and their properties – property charts and tables – representation of changes of state and process on T-S, H-S and P-h charts – characteristics of thermodynamic systems – ideal and practical cycles – air cycle – Carnot, Otto, Diesel and Brayton cycles – theoretical efficiencies – Rankine cycle and it's modifications – calculation of output and efficiencies – reversed heat engine cycle – refrigerating effect and COP (problems of elementary nature).

Module III (13 hours)

Compressors and refrigeration systems - air compressors - reciprocating and rotary compressors - principle of operation of compressors – refrigeration - vapor compression and absorption systems - principle of operation of refrigeration systems (problems of elementary nature)

Module IV (13 hours)

Conduction – Fourier heat conduction equation – thermal conductivity – one dimensional heat

Text Books

1. P.K.Nag, *Engineering Thermodynamics*, Tata Mc Graw-Hill

Reference Books

M. Achuthan, *Engineering Thermodynamics,PHI*

J.P Holman,*Heat transfer*, Tata Mc Graw-Hill

Ballaney,*Thermal Engineering*, Khanna Publishers

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

PE09 407(P): Electrical and Electronics Lab

Teaching scheme **Credits:** 2

3 hours laboratory classes per week

Objectives

- *The lab provides an opportunity to understand the basic electrical theories by conducting experiments. This will also provide them with sufficient experience in designing experiments to demonstrate or validate electrical theory.*

1. Study of starters (i) 3 point and 4 point starters for DC motors (ii) Star-delta, auto-transformer, DOL and rotor resistance starters for induction motors.

2. (a)(i)Obtain the Open Circuit Characteristics of the DC shunt generator at the rated speed and determine the shunt field critical resistance. (ii) Pre-determine the OCC at the given speed (b) Perform load test on the given DC shunt generator and plot the external characteristics.

3. Perform Break test on DC shunt and series motors and plot the following characteristics (i) output v/s efficiency (ii)) output v/s line current (iii) speed v/s torque (iv) line current v/s torque.

4. (a)Perform OC and SC test on single phase transformer and pre-determine the following (i) equivalent circuit (ii) efficiency (iii) regulation.

   (b) Perform load test on single phase transformer and determine efficiency and regulation.

5. Perform load test on three phase cage induction motor and plot the following Characteristics (i) efficiency v/s output (ii) slip v/s output (iii) power factor v/s output (iv) torque v/s output.
6. Calibrate the given single phase energy meter by (i) direct loading (ii) Phantom loading.
7. (i) Familiarization with electronic components, devices and equipments (ii) Study of CRO.
8. Set up full-wave bridge rectifier circuit with and without capacitor filter. Observe the input and output waveforms. Calculate ripple factor and regulation.
9. Design and set up following OP-Amp circuits (i) inverting and non-inverting amplifier (ii) Adder (iii) subtractor (iv) differentiator (V) integrator (vi) comparator
10. Design and set up half adder and full adder circuit.
11. Design and set up astable multivibrator using 555 timer.
12. Design and set up asynchronous counter using J-K flip flop.
13. Study the given 8085 microprocessor kit. Write and execute an assembly language program to add N numbers.
14. (i) Study the SCR converter circuit (ii) Control the speed of the given DC motor.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

PE09 408(P): Mechanical Engineering Lab

Teaching scheme **Credits:** 2
3 hours Practical per week

Objectives

- *To plan and conduct experiments to study and validate the performance of various measuring instruments and equipment*
- *To train the students to plan experiments for evaluating practical situations*
- *To understand how experiments shall be set up for experimental studies*

1. Estimation of hydraulic coefficients of orifices and mouth pieces
2. Calibration of venturimenter, orifice meter and flow nozzle meter
3. Calibration of triangular and rectangular notches
4. Performance test on rotodyanamic and reciprocating pumps
5. Performance test on two stroke and four stroke petrol and diesel engine
6. Calibration of pressure gauge
7. Calibration and use of temperature sensing devices – thermo couple, resistance thermo meters and pyrometers
8. Calibration and use of vibration pickups, displacement pickups and accelerometers

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester End Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record