NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

An Autonomous College under VTU
Bengaluru - 562 164

Outcome Based Education(OBE)/
Choice Based Credit System (CBCS) Curricula

SYLLABUS
I & II SEM B.E.
OUTCOME BASED EDUCATION CURRICULA

Scheme and Syllabus
with effect from Academic year
2016-17

PRINCIPAL
Nagarjuna College of Engineering & Technology
Devanahalli (Tq) Bengaluru

NAGARJUNA

COLLEGE OF ENGINEERING & TECHNOLOGY

Syllabus: I & II Sem B.E.
Outcome Based Education Curricula

VISION

Leadership and Excellence in Education.

MISSION

To fulfill the vision by imparting total quality education replete with the philosophy of blending human values and academic professionalism.

Scheme and Syllabus

With effect from Academic Year

2016 -17

PRINCIPAL
Nagarjuna College of Engineering & Technology
Devanahalli (Tq) Bengaluru (Dt.)-Pin: 562164

Scheme of Study - First Semester – Physics Cycle

Sl. No	Course Code	Course	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	16MAT11	Engineering Mathematics-I	MAT	4-0-0-4	5	100
2	16PHY12	Engineering Physics	PHY	4-0-0-0	4	100
3	16CEF13	Civil Engineering Foundation	CV	4-0-0-4	5	100
4	16CED14	Computer Aided Engineering Drawing	ME	2-0-4-0	4	100
5	16ELN15	Basic Electronics (IC)	EC	3-0-2-0	4	100
6	16PHL16	Engineering Physics Laboratory	PHY	1-0-2-0	2	100
7	16ENV17	Environmental Studies	CHE/CV	1-0-0-0	1	100
8	16PDP18	Personality Development Programme	HSS	1-0-0-0	1	100
9	16ENG19	Functional English (Mandatory)	HSS	1-0-0-0	-	-
Total				21-0-8-8	26	800

Scheme of Study - First Semester – Chemistry Cycle

Sl. No	Course Code	Course	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	16MAT11	Engineering Mathematics-I	MAT	4-0-0-4	5	100
2	16CHE12	Engineering Chemistry (IC)	CHE	4-0-2-0	5	100
3	16CCP13	Computer Concepts and C Programming	CS/IS	4-0-0-0	4	100
4	16MEF14	Mechanical Engineering Foundation (IC)	ME	3-0-2-0	4	100
5	16ELE15	Basic Electrical Engineering (IC)	EC	3-0-2-0	4	100
6	16CPL16	Computer Programming Laboratory	CS/IS	1-0-2-0	2	100
7	16CPH17	Constitution of India, Professional Ethics and Human Rights	HSS	1-0-0-0	1	100
8	16CSD18	Communication Skill Development	HSS	1-0-0-0	1	100
9	16KAN19	Kannada language (Mandatory)	HSS	1-0-0-0	-	-
Total				22-0-8-4	26	800

IC – Integrated Course L – Lecture T-Tutorials
P-Practical S – Self Study

PRINCIPAL
Nagarjuna College of Engineering & Technology
Devanahalli (Tq) Bangalore (D) Pin: 562164

Scheme of Study – Second Semester – Physics Cycle

Sl. No	Subject Code	Subject	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	16MAT21	Engineering Mathematics-II	MAT	4-0-0-4	5	100
2	16PHY22	Engineering Physics	PHY	4-0-0-0	4	100
3	16CEF23	Civil Engineering Foundation	CV	4-0-0-4	5	100
4	16CED24	Computer Aided Engineering Drawing	ME	2-0-4-0	4	100
5	16ELN25	Basic Electronics (IC)	EC	3-0-2-0	4	100
6	16PHL26	Engineering Physics Laboratory	PHY	1-0-2-0	2	100
7	16ENV27	Environmental Studies	CHE/CV	1-0-0-0	1	100
8	16PDP28	Personality Development Programme	HSS	1-0-0-0	1	100
9	16ENG29	Functional English (Mandatory)	HSS	1-0-0-0	-	-
Total				21-0-8-8	26	800

Scheme of Study - Second Semester – Chemistry Cycle

Sl. No	Course Code	Course	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	16MAT21	Engineering Mathematics-II	MAT	4-0-0-4	5	100
2	16CHE22	Engineering Chemistry (IC)	CHE	4-0-2-0	5	100
3	16CCP23	Computer Concepts and C Programming	CS/IS	4-0-0-0	4	100
4	16MEF24	Mechanical Engineering Foundation (IC)	ME	3-0-2-0	4	100
5	16ELE25	Basic Electrical Engineering (IC)	EC	3-0-2-0	4	100
6	16CPL26	Computer Programming Laboratory	CS/IS	1-0-2-0	2	100
7	16CPH27	Constitution of India, Professional Ethics and Human Rights	HSS	1-0-0-0	1	100
8	16CSD28	Communication Skill Development	HSS	1-0-0-0	1	100
9	16KAN29	Kannada language (Mandatory)	HSS	1-0-0-0	-	-
Total				22-0-8-4	26	800

IC – Integrated Course L – Lecture T-Tutorials
P-Practical S – Self Study

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Engineering Mathematics-I

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16MAT11	4:0:0:4	5	CIE:50 SEE:50	3 Hours	BS

Course Objectives:

This course will enable students to :

- The basic mathematical skills for engineering subjects.
- The concept of mathematical modelling of systems using differential equations.
- The fundamentals of Vector differentiation.
- The basics of linear algebra in solving system of equations.

Syllabus

Module - I

Determination of nth order derivatives of standard functions-problems. Leibnitz theorem for n^{th} order derivative of product of two functions(without proof)-problems-Taylor's and Maclaurin's series for functions of one variable-(statements only)- problems, Polar curves-angle between radius vector and tangent, length of the perpendicular from pole on the tangent , angle between two curves-problems, pedal equations for polar curves-problems. **10 Hours**

***Indeterminate forms-L' Hospital rule (statement only) - problems .**

Module - II

Derivative of arc lengths in Cartesian, parametric and polar forms (without proof)-problems. Curvature and Radius of Curvature in Cartesian, parametric, polar and pedal forms-problems. Partial derivatives basic problems, total derivatives, partial derivatives of composite functions-problems. **10 Hours**

***Jacobian definition and problems.**

Module -III

Vector Calculus and Applications: Scalar and vector point functions and their differentiations, vector differential operator∇, gradient, directional derivative, divergence, curl, solenoidal and irrotational vectors and Laplacian.

Integral Calculus: Evaluation of the reduction formula $\int Sin^n(x)dx$, $\int cos^n(x)dx$, $\int_0^{\Pi/2} sin^n(x)dx$, $\int_0^{\Pi/2} cos^n(x)dx$ where n is a positive integer. Reduction formula for $\int_0^{\Pi/2} sin^m(x)cos^n(x)dx$, where m and n are +ve integers (without proof) – problems.

***Leibnitz's rule for differentiation under the integral sign- standard problems** **10 Hours**

Module -IV

Solutions of ordinary differential equations of first order and first degree: Bernoulli's equations, Exact differential equations, Equations reducible to exact equations: Integrating factor of homogeneous equations, Integrating factor of the equation $f_1(x,y).y\,dx + f_2(x,y).x\,dy = 0$, Integrating factor of the equation Mdx + Ndy = 0 if $\frac{1}{n}\left(\frac{\partial m}{\partial y} - \frac{\partial n}{\partial x}\right) = f(x)$ and $\frac{1}{m}\left(\frac{\partial m}{\partial y} - \frac{\partial n}{\partial x}\right) = -g(y)$. Applications of Differential equations: Orthogonal trajectories, Newton's law of cooling. **10 Hours**

***Flow of electricity and laws of decay and growth.**

Module - V

Linear Algebra: Rank of the matrix by elementary transformations, solutions of system of linear equations: Gauss elimination method and Gauss Seidel method. Linear transformations and orthogonal transformations. Eigen values and Eigen vectors of a square matrix – problems. Rayleigh's power method to find the largest Eigen value and corresponding Eigen vector – problems. Cayley-Hamilton theorem (statement only) – problems. **10 Hours**

***Cayley-Hamilton theorem (statement only) – problems.**

Course Outcomes:

On completion of this course, the students are able to :

- Determine the n^{th} derivative of the functions of single variable and Express the given functions in the series form.
- Determine the angle between the two polar curves and express the polar curves in pedal form.
- Apply the vector and scalar operators in mechanical and electrical engineering applications.
- Solve the differential equations as applied to various engineering applications.
- Evaluate the system of linear equations and compute Eigen values and Eigen vectors.

Text Books:

1. Dr. B.S. Grewal: "Higher Engineering Mathematics", (Chapters 2-6,8,11,12), Khanna Publishers, New Delhi, 42nd Edition, 2012, ISBN : 9788174091956.
2. N.P. Bali and Dr. Manish Goyal: "A Text Book of Engineering Mathematics", (Chapters 3,5,7,11,12), Laxmi Publications (P) Ltd., New Delhi, 9th Edition, 2014. ISBN: 9788131808320.

Reference Books:

1. Erwin Kreyszig: "Advanced Engineering Mathematics", (Chapters 1,7-9,20), Wiley Pvt. Ltd., New Delhi, India, 9th Edition, 2011, ISBN 13: 9788126531356.
2. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", (Chapter: 1,2,5,11,19,21,23), S. Chand and Company Private Limited, New Delhi, 3rd Revised Edition, 2014, ISBN: 9788121938907.

E-Resources:

1. http://bookboon.com/en/essential-engineering-mathematics-ebook
2. https://www.free-ebooks.net/ebook/essential-engineering-mathematics
3. http://www.zums.ac.ir/ebooks/mathematics/essential-engineering-mathemat-ic.
4. https://archive.org/details/AdvancedEngineeringMathematics10thEdition

***Self Study topics to be studied by students and the students have to submit a report to the department.**

Engineering Physics

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16PHY12/22	4:0:0:0	4	CIE:50 SEE:50	3 Hours	BS

Course Objectives:

This course will enable students to :

- The concepts of Laser and its applications in various fields.
- The areas of solid state physics and quantum mechanics.
- Building up of models, design issues, practical oriented skills and problem solving challenges are the great task of the course.
- Basics of Optical fibers, Superconductors and Elasticity.
- Emerging field of Nano technology.

Syllabus

Module - I

Laser: Interaction of radiation with matter (induced absorption, spontaneous emission and stimulated emission), Einstein coefficients, Expression for Energy density. Requirements of lasing system, Condition for Laser action (meta stable state, population inversion). Construction and working of Nd-YAG laser and He-Ne Laser. Applications of lasers. Measurement of atmospheric pollution using Laser. Basic Principle of Holography, recording and reconstruction of Image on hologram and applications of holography. **10 Hours**

Module - II

Crystal Structure: Space lattice, Bravais lattice, Unit cell, Primitive cell, Lattice parameters. Seven Crystal systems, Miller indices. Expression for inter-planar spacing in terms of Miller indices. Atomic packing factor for SC, BCC and FCC. Crystal structure of Diamond and NaCl. Quartz crystal-properties and its applications. Bragg's law, Determination of wave-length of X-rays using Bragg's X-ray spectrometer Polymorphism and allotropy. **10 Hours**

Module - III

Quantum Mechanics: Wave Particle dualism, de Broglie hypothesis. Matter waves and their Characteristic properties. Definition of Phase velocity and group velocity, Relation between phase velocity and group velocity, Relation between group velocity and particle velocity. Davission-Germer Experiment. Heisenberg's uncertainty principle and its application (Non-Existence of electron in nucleus).Wave function,

Properties and physical significance of wave function, Probability density and Normalization of wave function. Setting up of one dimensional time independent Schrodinger's wave equation. Eigen values and Eigen functions. Applications of Schrodinger's wave equation. Energy Eigen values and Eigen functions for a particle in one dimensional potential well of infinite height. **11 Hours**

Module - IV

Optical Fibers: Principles of optical fiber, Angle of acceptance, Numerical aperture (derivation) Types of Optical fibers. Attenuation. Applications: Fiber optic communication. Advantages and limitations of optical fiber communication. **Superconductors:** Definition, Meissner effect. Type I and Type II superconductors, BCS theory (qualitative), high temperature superconductors Applications of superconductors: Superconducting magnets, Maglev, Josephson Effect, quantum interference (qualitative) SQUID, applications. **10 Hours**

Module - V

Science of Nano materials: Introduction, Quantum structures, Variations of density of states with energy for different quantum structures (qualitative), Synthesis of Nano materials : Top down and bottom up approach. Synthesis of nano materials -Ball Milling Sol-Gel methods, Carbon nano tubes (CNT), Structure of CNT. Synthesis of carbon nano tubes-Arc discharge method and pyrolysis. Properties and Applications. **Elasticity:** Introduction. Stress, Strain, Hooke's law, Young's modulus, bulk modulus, Rigidity modulus (qualitative), Poisson's ratio. Experimental determination of Young's modulus of a rectangular bar as single cantilever beam. **10 Hours**

Course Outcomes:

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

- Use principles of Laser for engineering applications.
- Apply the knowledge of crystal structure to study various engineering materials.
- Demonstrate the knowledge of formulation of quantum mechanical equations to solve engineering problems.
- Develop firm understanding of superconductors and optical fibers.
- Apply the basic concepts of elastic properties of materials and Nano materials to design modern instruments.

Text Books:

1. M N Avadhanulu, P G Kshirsagar: "Text Book of Engineering Physics", (Chapters 13,14,16,18,24), S Chand and Company Ltd., New Delhi, 2014, ISBN: 9788121908177.

2. Prof. S P Basavaraju: "Engineering Physics", (Chapters 1,2,5-8,10) Subhash Stores, Bangalore, 2nd Edition, 2015, ISBN: 9789383214501.

Reference Books:

1. M. Ali Omar: "Elementary Solid State Physics", (Chapters 1,6), Pearson Education, 2013, ISBN: 9788177583779.
2. Ajoy Ghatak: "Optics", (Chapters 21,26,27), Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi, 5th Edition, 2013, ISBN 13: 9781259004346.
3. Wiley Precise Text: "Engineering Physics", (Chapters 3,7,8,11,13,15), Wiley India Pvt. Ltd., New Delhi, 1st Edition, 2014, ISBN: 9788126543151.

E-Resources:

1. http://www.markfox.staff.shef.ac.uk/ PHY332 /phy332 _notes.pdf
2. http://nptel.ac.in /courses/115101010/

Civil Engineering Foundation

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CEF13/23	4:0:0:4	5	CIE:50 SEE:50	3 Hours	EFC

Course Objectives:

This course will enable students to :

- The basic knowledge of Civil engineering.
- Different types of infrastructure and smart city concepts.
- The force/force systems on an object/structural element under static conditions.

Syllabus

Module - I

Introduction to Civil Engineering: Scope of different fields of civil engineering-surveying Building materials, Construction technology, Geotechnical engineering, Structural engineering, Hydraulics, Water resources and irrigation engineering, Transportation Engineering, Environmental engineering etc.

Types of Infrastructure: Types of infrastructure, Role of civil engineer in the infrastructural development, effect of infrastructural facilities on socio-economic development of a country.

Roads: Classification of roads and their functions, Comparison of flexible and rigid pavements (advantages and limitations)

Bridges: Types of bridges and culverts, RCC, Steel and composite bridges.

Dams: Different types of dams based on material, structural behaviour and functionality with simple sketches.

Building Materials: Bricks and Blocks Classification and Quality Building Stones and their properties And uses.

Cement: Types of Cement, Steel different types.

Concrete: Ingredients of Concrete-Grade of Concrete. **10 Hours**

Module - II

Prefabricated structures: Comparison with monolithic construction, Advantages and limitations, applications.

Construction safety: Importance, Construction safety measures.

Smart Cities: Concept, Features, Advantages and limitations.

Bye-laws: Necessity, Basic bye-laws.

Introduction to Civil Engineering Mechanics: Basic idealizations of Particle, Continuum and Rigid Body and its Characteristics. Types of Forces. Classification of Force System.

Principle of Physical Independence of Forces, Principle of Transmissibility of Forces: Introduction to SI Units, Couple, Moment of a Couple. Characteristics of Couple, Moment of a Force. Equivalent Force-Couple System. Numerical Problems on Moment of Forces and Couples and Equivalent Force-Couple System. **10 Hours**

Module - III

Analysis of Force System: Concurrent Force System-Composition of Forces- Definition of Resultant. Composition of Coplanar-Concurrent Force system. Parallelogram Law of Forces Principle of Resolved Parts. Numerical Problems on Composition of Coplanar Concurrent Force System.

Non-Concurrent Force System: Composition of Coplanar- Non-Concurrent Force System. Varignon's Principle of Moments. Numerical problems on Composition of Coplanar Non Concurrent Force System. **10 Hours**

Module - IV

Equilibrium of Concurrent and Non Concurrent Forces: Equilibrium of Forces-Definition of Equilibrant, Conditions of Static Equilibrium for Different Force Systems, Lami's Numerical Problem on Equilibrium of Coplanar- Concurrent and Non-Concurrent Force Systems.

Support Reactions: Types of Loads and Supports. Statically Determinate Beams. Numerical Problems on Support Reactions for Statically Determinate Beams with Point Loads (Normal and Inclined), Uniformly Distributed Loads and Varying Loads. **10 Hours**

Module - V

Centroid and Centre of Gravity: Definition, Derivation of expressions for Centroidal distances of simple planar laminas like Rectangle, Triangle, Quarter and Semicircle. Determination of Centroidal distances of Compound Laminas.

Moment of Inertia: Introduction, Definition, Theorems of Perpendicular and Parallel Axis. Concept of Axis of Symmetry, Derivation of expressions for Moment of Inertia of simple planar laminas like Rectangle, Triangle, Quarter, Semicircle and Circle. Definition of Polar Moment of Inertia, Radius of Gyration. Determination of Moment of Inertia. Polar Moment of Inertia, Radius of Gyration of Compound Laminas about Centroidal Axis and about any Specified Reference Line. **10 Hours**

Course Outcomes:

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

- Explain the importance of Civil engineering, its scope of study, knowledge about roads, bridges and dams.
- Recognize pre fabricated structures and familiarize with the concepts of smart cities.

- Apply the concepts and principles of force system to a given coplanar concurrent force system.
- Apply the concepts and principles of mechanics to a given coplanar-non concurrent force system.
- Compute centre of gravity and moment of inertia for a given lamina.

Text Books:

1. F. P. Beer and E. R. Johnston: "Vector Mechanics for Engineers – Volume I- Statics", (Chapter 1-5,7,9), Tata McGraw Hill, 9th Edition, 2011, ISBN: 978-0077402280.
2. S. S. Bhavikatti, "Elements of civil Engineering and Engineering Mechanics", (Chapter 1-5,8), New Age International Pvt. Ltd., New Delhi, 5th Edition, 2015, ISBN:978-81-224-3003-5.

Reference Books:

1. P. G. Varghese, "A Textbook Building Materials", (Chapter 1,3,19), PHI Learning publication, 2nd Edition, April 2015, ISBN: 81-203-2848-5.
2. Neville A. M and Brooks J. J, "Concrete Technology", (Chapter 1,2), ELBS Edition, London, 2nd Edition, 2010, ISBN: 978-81-317-0536-0.
3. M.G. Shah, C.M. Kale and S.Y. Patki, "Building Drawing", (Chapter 1), Tata McGraw Hill Education Pvt. Ltd., New Delhi, 5th Edition, 2012, ISBN- 13: 978-0074638767.

E-Resources:

1. http://elearning.vtu.ac.in/CV1323.html
2. http://moud.gov.in/model
3. https://en.wikipedia.org/wiki/smart_city
4. civildigital.com/prefabricated-structures-prefabrication-concept-components-advantages-ppt/
5. www.labour.gov.hk/eng/public/os/D/Constructionsite.pdf

Computer Aided Engineering Drawing

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CED14/24	2:0:4:0	4	CIE:50 SEE:50	3 Hours	EFC

Course Objectives:

This course will enable students to :

- The importance of engineering drawing as a means of communication.
- The usage of CAD software.
- The concept of orthographic and isometric projections.
- The development of lateral surfaces of solids.

Syllabus

Module - I

Introduction to Computer Aided Sketching: Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP and LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering (Demonstration only). **09 Hours**

Module - II

Orthographic Projections: Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems).

Orthographic Projections of Plane Surfaces: Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates). **15 Hours**

Module - III

Projections of Solids: Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions (No problems on octahedrons and combination solid). **18 Hours**

Module - IV

Development of Lateral Surfaces of Solids: Development of lateral surfaces of regular prisms, pyramids, cylinders and cones resting with base on HP, their frustums and truncations. Development of a simple tray. **18 Hours**

Module - V

Isometric Projection (Using Isometric Scale Only): Introduction, Isometric scale,Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids. **18 Hours**

Course Outcomes:

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

- Draw the front, top and side views of points, lines and planes and get exposed to the drafting software.
- Visualize and draw the orthographic projections of simple solids in various positions.
- Develop the lateral surfaces of solids and to create the isometric projections of simple objects.

Text Books:

1. N.D. Bhatt and V.M. Panchal: "Engineering Drawing", (Chapters 1-5) Charotar Publishing House, Gujarat, 49th Edition, 2008, ISBN : 81-85594-58-9.
2. BasantAgrawal and C M Agrawal: "Engineering Drawing".McGraw Hill Education India Private Limited, (Chapters 1- 4,7-11,13,15), 2nd Edition, 2013, ISBN-13: 978-1259062889.

Reference Books:

1. S. Trymbaka Murthy: "Computer Aided Engineering Drawing", (Chapters 5-8,10, 11), I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd Edition, 2010, ISBN: 978-93-8057860-6.
2. Luzadder Warren J., Duff John M: "Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production", (Chapters 4,5,10,11), Eastern Economy Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2005, ISBN 13: 978-01-333-8427-7.
3. M.H. Annaiah, "Computer Aided Engineering Drawing", (Chapters 1-6), New Age International Publisher, New Delhi, 4th Edition, 2010, ISBN: 978-81-224-2779-0.

E-Resources:

1. https://www.youtube.com/watch?v=hET58JV-oZI
2. https://www.youtube.com/watch?v=ZFRcAfBSEhQ

Conducting classes: Classes may be conducted in two slots per week, of 3 Hours each(Instruction 1 hr. + Sketching and Practice 2 hr.)

Scheme of Examination:

Continuous Internal Evaluation (CIE):

CIE – 1	-	30 marks
CIE – 2	-	30 marks
Surprise test	-	10 marks
Submission of Sketch Book	-	30 marks.
Total	-	100 marks

Semester End Examination (SEE):

Part A - Module 1 or Module 2	-	30 marks
Part B - Module 3		40 marks
Part C - Module 4 or Module 5	-	30 marks
Total	-	100 marks

Note: One question to be set from module 1,2,4 and 5 each. Two Questions are to be set from Module 3. Students have to answer any one question from each part.

Basic Electronics (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16ELN15/25	3:0:2:0	4	CIE:50 SEE:50	3 Hours	EFC

Course Objectives:

This course will enable students to :

- Basic concepts of semiconductor devices.
- The fundamentals of digital electronics and operational amplifiers.
- The basic principles of communication systems.

Syllabus

Module - I

Semiconductor Diodes and Applications: PN-junction diode and its characteristics, diode approximations, DC load line analysis, diode applications: Half-Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Zener diode as voltage regulator(with no load), Numerical examples as applicable. **08 Hours**

Module - II

Bipolar Junction Transistors: BJT Operation, BJT Voltages and Currents, BJT amplification: voltages and currents, Common Base characteristics, Common Emitter characteristics and Common Collector Characteristics, DC load line and Bias Point, Base Bias, Voltage divider bias, Numerical examples as applicable. **08 Hours**

Module - III

Digital Electronics: Introduction, switching and Logic levels, digital waveforms, Number Systems, Conversions of number system, addition and subtraction using 1's and 2's complement, Boolean Algebra, De Morgan's theorem, Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate. Algebraic Simplification, NAND and NOR Implementation, Half adder, Full adder. **07 Hours**

Module - IV

Operational Amplifiers: Introduction to OP-AMP, Block diagram and stages, Pin configuration of OP-AMP. Ideal versus practical characteristics of OP-AMP, Virtual ground concept, Inverting and Non Inverting OP-AMP circuits, OP-AMP applications: Voltage Follower, Adder, Subtractor, Integrator, Differentiator, Numerical examples as applicable. **07 Hours**

Module - V

Communication Systems: Introduction, Elements of Communication Systems, Modulation, Need for modulation, Amplitude Modulation, Spectrum Power, AM Detection (Demodulation), Frequency modulation, comparison of AM and FM.

Feedback Concepts, Oscillators: Operation of RC phase shift oscillator (using only BJT), Numerical Examples as applicable. **08 Hours**

List of Experiments:

Hardware experiments:

1. Verification of all logic gates.
2. Simplification of Boolean expression and verify using gates.
3. Inverting amplifier using OP-AMP.
4. Non inverting amplifier using OP-AMP.

Virtual Lab experiments:

5. V-I Characteristics of Zener Diode.
6. Common Emitter Characteristics.
7. Half wave rectifier.
8. Full wave rectifier.

Demonstration experiments:

9. RC phase shift oscillator.
10. AM modulation.

Course Outcomes:

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

- Analyze the characteristics of semiconductor devices.
- Select and use semiconductor diodes and transistors for various applications.
- Apply the knowledge of digital electronics using logic gates.
- Demonstrate the use of OP-AMPs.
- Analyze the working of communication system and oscillators.

Text Books:

1. David A Bell: "Electronic Devices and Circuits", (Chapters 1-3), Oxford University Press, New Delhi, 5th Edition, 2008, ISBN: 9780195693409.
2. Kothari. D.P., and I. J. Nagrath: "Basic Electronics", (Chapters 4,5), McGraw Hill Education (India) Private Limited, 1st Edition, 2014, ISBN: 9789332901582.

Reference Books:

1. George. Kennedy: "Electronic Communication Systems", TMH, 4th Edition, 1993, ISBN: 0074636820.
2. Boylestad .R.L., and Louis. Nashlesky: "Electronic Devices and Circuit Theory", Pearson Education, 10th Edition, 2012, ISBN: 9788131764956.

E-Resources:

1. http://www.vlab.co.in
2. http://www.basicelectronics.iitkgp.ernet.in

Engineering Physics Lab

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16PHL16/26	1:0:2:0	2	CIE:50 SEE:50	3 Hours	BS

Course Objectives:

This course will enable students to :

- The working knowledge of fundamentals of electronics.
- Experimental skills and practical applications engineering physics.
- Basics of instrumentation, measurement, data acquisition, interpretation and analysis.

Syllabus

List of Experiments:

1. Laser Diffraction (Determination of wavelength of laser using diffraction grating).
2. Planck's Constant (Determination of Planck's constant).
3. Photodiode characteristics (Study the V-I characteristics of Photodiode).
4. Zener Diode characteristics (Study the V-I characteristics of Zener Diode).
5. Energy gap of a semiconductor (Determination of Energy gap of a semiconductor) .
6. Dielectric constant (Determination of dielectric constant of a dielectric material).
7. LCR circuits (Determination of resonance frequency, quality factor in a Series and Parallel LCR circuit).
8. Black Box (To identify and determine the values of unknown passive electrical elements (L,C,R)).
9. Single Cantilever (Determination of Young's modulus of a given material bar).
10. Verification of Stefan's law (Verification of Stefan's law of black body radiation).

Virtual Lab experiments:

1. Torsional Pendulum (Determination of rigidity modulus of the suspension wire of a torsional pendulum).
2. Ultrasonic Interferometer (Determination of velocity of ultrasonic waves in the given liquid).

Course Outcomes

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

- Apply the practical knowledge of physics in engineering applications.
- Identify the characteristics of semiconductor devices.
- Develop skills to choose the appropriate electronic and electrical components in practical applications.

E-Resources:

1. vlab.amrita.edu/?sub=1andbrch=282andsim=1512andcnt=1
2. vlab.amrita.edu/index.php?sub=1andbrch=280andsim=1518andcnt=4

Environmental Studies

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16ENV17/27	1:0:0:0	1	CIE:50 SEE:50	2 Hours	HSS

Course Objectives:

This course will enable students to :

- Basic concepts of Environmental Science.
- Importance of Carbon Credits, ozone level depletion, global warming and green house effects.
- Importance of pollution free air, water and food.

Syllabus

Module - I

Environment and Effects of Human Activities

Environment: Definition, components of Environment. Ecosystem, Balanced ecosystem.

Effects of Human Activities: Food, Shelter, Economic and Social security. Impacts of Agriculture, Housing, Industry, Mining and Transportation, Environmental Impact Assessment. **03 Hours**

Module - II

Natural resources and Energy

Natural resources: Availability and quality aspects, Water borne disease and Water induced diseases, Fluoride problem in drinking water, Mineral resources.

Energy: Different types of energy, Conventional and Non Conventional sources of energy. Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Fossil Fuels. **03 Hours**

Module - III

Environmental Pollution and Global Environmental Issues

Environmental Pollution: Water pollution, Air pollution, Noise pollution, Land pollution, Radio-active pollution, Automobile pollution, Effects- Global warming, Acid Rain and Ozone layer depletion and controlling measures.

Global Environmental Issues: Population Growth, Urbanization, Land Management, Water and Waste Water Management. **04 Hours**

Module - IV

Solid Waste management: Introduction, E-waste management and Biomedical Waste Management – Sources, Characteristics and Disposal methods. **03 Hours**

Module - V

Environmental Acts and Regulations: Applications of GIS, Environmental Acts and Regulations, Functions of Central and State Pollution control boards, Role of Government, Role of Non-governmental Organizations (NGOs), Women Education. **03 Hours**

Course Outcomes:

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

- Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
- Develop preservation skill of natural resources.
- Recognize the principles of environmental issues that apply to air, land and water on a global scale.
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- Discuss the provisions of environmental acts and regulations.

Text Books:

1. Anil Kumar De and Arnab Kumar De: "Environmental Studies", (Chapters 1-5), New Age International Pvt. Ltd., New Delhi, 3rd Edition, 2015, ISBN: 978- 81-224-3827-7.
2. Meenakshi P: "Elements of Environmental Science and Engineering", (Chapters 1-6,8-12), Prentice-Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2006, ISBN: 81-203-2774-8.
3. Nandini N, Sunitha N and Sucharita T: "Environmental Studies", (Chapters 1-3,5-7), Sapna Book House Pvt. Ltd., Bangalore, 7th Edition, 2012, ISBN:81- 280-0657-6.

Reference Books :

1. Joseph B, "Environmental Studies", (Chapters 1-3,5-7), Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2nd Edition, 2010, ISBN(13): 978-0-07-064813-5.
2. Venugopal Rao P, "Principles of Environmental Science and Engineering", (Chapters 2,3,6-8,11), Prentice-Hall of India Pvt. Ltd., New Delhi, 3rd Edition, 2008, ISBN: 978-81-203-2893-8.
3. Manjunatha D. L, "Environmental Studies", (Chapters 2-5,8-11), Pearson Education, New Delhi, 1st Edition, 2007, ISBN: 81-317-0912-4.

E-Resources:

1. http://nptel.ac.in/courses/120108002/
2. https://www.youtube.com/watch?v=slsrZEI-wOk.

Personality Development Programme

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16PDP18/28	1:0:0:0	1	CIE:50 SEE:50	2 Hours	HSS

Course Objectives:

This course will enable students to :

- Develop mental clarity and emotional strength in the students to handle the challenges faced by them.
- Enhance communication skills and develop leadership and team building skills.
- Improve academic performance by increasing concentration and time management.

Syllabus

Module - I

Introduction: Introduction of YES!+ in global perspective; Importance of Commitment and participation; Listening and communication; Layers of existence, Importance of breath, Breathing exercises, Pranayama and guided relaxation. Appreciating the opposite values, how to give 100%, vacillation of mind and importance of present moment, impact of sound on mind, Meditation: The inner engineering of the human mind. **06 Hours**

Module - II

Concentration: Taking responsibilities, Handling situations when mistakes happen, Interactive processes to bring out the sharing and caring aspects, Getting rid of mental blocks. Accepting people and situation, Managing inter-personal relations at home and at work, How to enhance Concentration – special pranayama techniques along with Sudarshan kriya. **06 Hours**

Module - III

Self Esteem and Mind Management: Meaning of Ego, How to handle Ego, Handling peer pressure, Secret of Relationships and making a positive difference, taking a stand against negative influences, Meditation and breathing exercises. Scientifically designed Yoga asanas, Sudarshan Kriya (powerful and rhythmic breathing mediation technique). How to eat healthy and keep prana/energy level high. **06 Hours**

Module - IV

Relationships / Career : Law of attraction, Enthusiasm and ways to develop it, Dealing with Parents, Understanding career opportunities, Making intelligent career

choices, How to choose a career that satisfies you, Frontiers in Present Engineering and Career counselling, Career Counselling and Setting goals. **06 Hours**

Module - V

Time Management and Leadership: Making best use of our time, Time management matrix, Karma Yoga, Leading by example, Service to society: the key to happiness and creativity, Group projects to improve community and college campus, Joy of Sharing, Pranayama and Aura Meditation. Science and spirituality: Two sides of the same coin. **06 Hours**

Course Outcomes:

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

- Realize one's own potential and build self-confidence.
- Improve concentration power and there by improving academic performance.
- Use meditation and Yoga to build healthy mind and body.
- Release stress and achieve calmness of mind with the techniques taught.

Text Books:

1. H H Sri Sri Ravi Shankar: "Wisdom for the New Millennium", Sri Sri Publication Trust.
2. H H Sri Sri Ravi Shankar: "The Art of Stress Free Living", Sri Sri Publication Trust.

Reference Books:

1. H H Sri Sri Ravi Shankar: "Management Mantras".
2. Dr. D K Hari and Dr Hema Hari: "Creation-Srishti Vignana".

E-Resources:

1. www.artofliving.org/research
2. www.bharatgyan.com

Functional English

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16ENG19/29	1:0:0:0	Nil	SEE:100	2 Hours	MNC

Course Objectives:

This course will enable students to :

- Understand the significance of English language as a tool for global communication.
- Develop and enhance the linguistic and communicative competence of the students.
- Hone the skills of reading, writing, listening, and speaking.
- Expose the students to various forms of personal and professional communication.

Syllabus

Module - I

Introduction, Importance of Languages, Grammar, Parts of Speech, Usage of Preposition and Article, Punctuation.

Tenses and Degrees of Comparison **03 Hours**

Module - II

Transformation of Sentences Active-Passive, Affirmative-Negative, Exclamatory-Assertive, Interrogative-Assertive, Kinds of sentences.

Direct-Indirect Speech **02 Hours**

Module - III

Vocabulary Usage Homonyms, Correcting Spelling, One-word equivalents.

Precise Writing 3 Hours Essay/Report Writing **03 Hours**

Module - IV

Letter Writing Personal, Official, Applications.

Idioms and Phrases Meaning and Usage in sentences. **02 Hours**

Module - V

Comprehension of an unseen passage, Elaboration Expansion of ideas, proverbs.

Presentation: Preparation of materials and presentation – steps. **02 Hours**

Course Outcomes:

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

- Use the dynamics of communication.
- Read and write effectively.
- Use better presentation skills.

Text Books:

1. Leo Jones and Richard Alexander: "New International Business English", Cambridge University Press, Updated Edition, 2000, ISBN-13: 978-0521774710.
2. Wren, Martin: "High School English Grammar and Composition", S Chand and Company-New Delhi, 2016, ISBN-13: 978-9352530144.

Reference Book:

1. John Seely: "Oxford Guide to Effective Writing and Speaking: How to Communicate Clearly", Oxford University Press, UK, 3rd Edition, 2013, ISBN- 13: 978-0199652709.

E-Resources:

1. http://www.teachingenglish.org.uk/
2. http://www.edb.gov.hk/en/curriculum-development/kla/eng-edu/references

Engineering Chemistry (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CHE12/22	4:0:2:0	5	CIE:50 SEE:50	3 Hours	BS

Course Objectives:

This course will enable students to :

- Basic concepts of engineering chemistry.
- Engineering chemistry for building technical competence in industries, research and development.
- The application of engineering chemistry in a comprehensive, economic, environmental and social context.
- Basics of polymer and Nano composites.

Syllabus

Module - I

Electrochemistry and Battery Technology

Electrochemistry: Introduction, Derivation of Nernst equation for single electrode potential. Types of electrodes: metal-metal ion, metal-metal salt ion, gas, amalgam, redox and ion selective. Reference electrodes – calomel electrode, Ag - AgCl electrode. Measurement of electrode potential using calomel electrode, Electrolyte concentration cells, numerical problems on electrolyte concentration cells.

Battery technology: Introduction, Classification of batteries – primary, secondary and reserve batteries, battery characteristics-cell potential, current, capacity, electricity storage density, cycle life, shelf life and energy efficiency. Classical batteries – construction, working and applications of Lead acid battery, Construction, working and applications of Li-ion batteries. Fuel cell – Introduction, difference between conventional cell and fuel cell, limitations and advantages. Construction, working and applications of CH_3OH-O_2 fuel cell with H_2SO_4 electrolyte. **10 Hours**

Module - II

Corrosion Science and Metal Finishing

Corrosion Science: Introduction, electrochemical theory of corrosion, Galvanic series, types of corrosion - differential metal corrosion, differential aeration corrosion - pitting and water line corrosion, stress corrosion (caustic embrittlement in boilers), Factors affecting the rate of corrosion: Nature of metal, Nature of corrosion

product, ratio of anodic and cathodic areas, nature of medium - P^H, Conductivity and temperature. Corrosion control: metal coatings – galvanization and tinning, cathodic protection - sacrificial anodic and impressed current methods Metal finishing: Introduction, Technological importance, Electroplating, Factors influencing the nature of electro deposit- Current density, plating bath - concentration of metal ion, complexing agents, pH, temperature, throwing power. Electroplating of decorative Cr. Electroless plating –Introduction, electroless plating of copper, manufacture of PCB by electroless plating of copper. **10 Hours**

Module - III

Chemical fuels and Photovoltaic cells :

Chemical fuels: Introduction, classification, Calorific value-gross and net calorific values, determination of calorific value of a solid/liquid fuel using Bomb calorimeter and numerical problems. Petroleum cracking: Introduction, Fluidized catalytic cracking, Reformation of petrol, Petrol knocking – mechanism and their ill effects, anti knocking agents, Fuel rating system – Octane and Cetane number, catalytic converter.

Photovoltaic cells: Introduction, Photovoltaic cells – construction, working and advantages, Design: modules, panels and arrays. Production of solar grade silicon by union carbide method, doping of silicon by diffusion technique (n and p type), zone refining. **10 Hours**

Module - IV

Water technology: Impurities in the water, boiler feed water, scale and sludge formation, Hardness – definition, types of hardness and its determination by EDTA method, Alkalinity - determination by phenolphthalein and methyl orange indicator. Determination of dissolved (DO) oxygen by Winkler's method. Biological Oxygen Demand (BOD)–definition, determination and numerical problems. Chemical Oxygen Demand (COD) –determination and numerical problems. Sewage treatment – Primary treatment, Secondary treatment by activated sludge treatment and tertiary treatment. Potable water –softening of water by ion exchange process. Electrodialysis, Desalination of sea water by reverse osmosis. **10 Hours**

Module - V

Polymer Nano composites and Instrumental methods of analysis

Polymer Nano composites: Introduction Overview of Nanocomposites, classification,Properties and applications - Nano clay-reinforced composites. Carbon Nano tube, CNT-reinforced composites. Nano fibre and inorganic particle-reinforced

composites. Instrumental methods of analysis: Theory, Instrumentation and applications of Potentiometry, Conductometry, Colorimetry and Flame photometry.

10 Hours

List of Experiments:

1. Determination of Total Hardness of a sample of water using disodium salt of EDTA.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.
3. Conductometric estimation of an Acid mixture (HCl and CH_3COOH) using standard NaOH solution.
4. Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.
5. Determination of total alkalinity of water sample.

Virtual Lab Experiments

1. Flame photometric estimation of metal ions in the given sample of water.
2. Spectrophotometric estimation of metal ions.
3. Acid-Base titration of strong acid v/s strong base.
4. Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.
5. Measurement of electrode potential (EMF) with respect to metal electrodes.

Course Outcomes:

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

- Use the knowledge of electrochemistry in analysis of water and familiarize with the selection criteria for commercial battery systems according to different applications.
- Investigate the ill effects of corrosion by adopting the appropriate remedial measures and modification of surface properties of metals to develop resistance to corrosion.
- Differentiate between various forms of energy.
- Identify water contamination and take appropriate preventive measures.
- Use the knowledge of Polymer Nano composites in the material selections for engineering applications.

Text Books:

1. Palanna O. G: "Engineering Chemistry", (Chapters 1-8), Tata McGraw Hill Education Pvt. Ltd., New Delhi, 1st Edition, 2011, ISBN-13: 978-0-07-106834-5.
2. Mahesh B, and Roopashree B: "Engineering Chemistry", (Chapters 1-3,5), Sunstar Publisher, Bangalore, 2nd Edition, 2015, ISBN: 978-93-85155-70-3.

3. Kulkarni V. R. and Ramakrishna Reddy K, "Engineering Chemistry", (Chapters 1-10), New Age International Publishers, New Delhi, 1st Edition, 2016, ISBN: 978-81-224-3990-8.

Reference Books:

1. Kuriacose J. C. and Rajaram J: "Chemistry in Engineering and Technology", (Chapters 13-19), Tata McGraw Hill Education Private Limited, New Delhi, 5th Edition, 2010, ISBN-13: 978-0-07-451735-2.
2. Puri, Sharma and Pathania: "Principles of Physical Chemistry", (Chapters 22-24,28), Vishal Publishing Co., Jalandhar, 44th Edition, 2011, ISBN: 81-88646-74-1.
3. Jeffery G. H., Bassett J., Mendham J and Denny R.C., "Vogel's text book of quantitative inorganic analysis", (Chapters 2,3,10,13,15,17), Addison Wesley Longman Inc., New York, 5th Edition, 1989, ISBN: 981-235-882-X.

E-Resources:

1. http://vlab.amrita.edu/index.php
2. http://nptel.ac.in/courses/113108051/

Computer Concepts and C Programming

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CCP13/23	4:0:0:0	4	CIE:50 SEE:50	3 Hours	EFC

Course Objectives

This course will enable students to :

- The basic concepts of computer system and C programming language.
- Flowcharts and algorithms.
- Problem solving skills using C language.
- Modular programming.

Syllabus

Module - I

Introduction to Computer System: Software, classification of software, compilers, interpreters, operating system and types of operating system, networks: Types of networks, Servers, Fundamentals of problem solving: The basic model of computation, main programming structure, Algorithm, Flowchart. Introduction to C Language: Basic concepts in a C program, constants, variables, volatile, declaration and initialization of variables, data types, Assignment statements. **10 Hours**

Module - II

Operators and Expressions: Precedence and associativity, type conversions, managing input/output functions, Programming examples and exercise.
Decision making: Decision making statements: if, if-else, nested if-else, cascaded if-else, switch statement. **10 Hours**

Module - III

Looping statements: for, while, do-while, Branching statements: goto, break and continue, Programming examples and exercises.
Arrays: Introduction, one-dimensional array: declaration, initialization, Two dimensional arrays: initialization, declaration, programming examples and exercises. **10 Hours**

Module - IV

Functions: Introduction to functions, types of functions, definition, elements of user defined functions. Category of user defined functions, parameter passing mechanism, Recursion, programming examples and exercise. **10 Hours**

Module - V

Strings, Structures and Pointers: Introduction to strings, declaration and initialization, string handling functions, Structures: Introduction, definition, declaration, initialization, accessing structure members, programming examples and exercise, Pointers: definition, initialization of pointer variables, accesses the address of a variable. **10 Hours**

Course Outcomes

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

- Describe the basics of computer system and C language.
- Evaluate expressions using C operators.
- Use arrays and looping concepts in programming.
- Develop modular programming using C.
- Construct the programs using structures and pointers.

Text Books:

1. E. Balaguruswamy: "Programming in ANSI C ", (Chapter 2-11,14) , Tata McGraw-Hill, India, 5th Edition, 2010, ISBN: 0070681821.
2. Vikas Gupta: "Computer Concepts and C Programming", (Chapter 1,5-7), Dreamtech Press, New Delhi, 2010, ISBN: 9789351194705.

Reference Books:

1. Behrouz A. Forouzan: "Computer Science", A Structured programming approach using C", Thomson India Edition, India, 2nd Edition, 2007, ISBN: 1844807002.
2. Byron Gottfried, Schaum's: "Programming with C", Schaum's Outlines, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 2000, ISBN: 978-0070240353.

E-Resources:

1. www.tutorialspoint.com/cprogramming_tutorial.pdf
2. phy.ntnu.edu.tw/~cchen/pdf/ctutor.pdf

Mechanical Engineering Foundation (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16MEF14/24	3:0:2:0	4	CIE:50 SEE:50	3 Hours	EFC

Course Objectives

This course will enable students to :

- The fundamental concepts related to renewable and non-renewable energy resources.
- The working principles of various machines, prime-movers and robots.
- The technique of various metal joining processes such as welding, brazing and soldering.
- The basics of various machining processes.
- The working principle of Refrigeration and Air-conditioning systems.

Syllabus

Module - I

Energy Resources: Non-renewable and renewable energy resources.

Solar Power: Solar Radiation, Solar constant (definition only), Solar Thermal energy harvesting, ex: liquid flat plate collectors, solar ponds (principle of operation only), Solar photovoltaic principle.

Wind Power: principle of operation of a typical windmill.

Hydro Power: Principles of electric power generation from hydropower plants.

Nuclear Power: Principles of Nuclear power plants.

Steam Formation and Application of steam: Classification of boilers, Lancashire boiler, Babcock and Wilcox boiler, Applications of steam. **09 Hours**

Module - II

Turbines and IC Engines

Steam turbines: Classification, Principle of operation of Impulse and reaction turbines, Delaval's turbine, Parson's turbine (No compounding of turbines).

Gas turbines: Classification, Working principles and Operations of Open cycle and Closed cycle gas turbines.

Water turbines: Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine.

Internal Combustion Engines: Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines, PV diagrams of Otto and Diesel cycles. **09 Hours**

Module - III

Refrigeration and Air-Conditioning

Refrigerants: Properties of refrigerants, list of commonly used refrigerants. **Refrigeration:** Definitions – Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, unit of Refrigeration. Principle and working of vapour compression refrigeration and vapour absorption refrigeration.
Air-Conditioning: Principles and applications of air conditioners, Room air conditioner. Simple calculations related to vapour compression refrigeration system, to find out refrigeration effect, power consumption of the compressor and COP. **07 Hours**

Module - IV

Engineering Materials and Joining Processes

Engineering Materials: Types and applications of Ferrous and Nonferrous metals and alloys.

Composites: Introduction, Definition, Classification and applications (Air-craft and Automobiles).

Soldering, Brazing and Welding: Definitions, classification and method of Soldering, Brazing and Welding. Differences between Soldering, Brazing and Welding. Description of Electric Arc Welding and Oxy-Acetylene Welding. **07 Hours**

Module - V

Machine Tools, Robotics and Automation

Machine Tools: Working principle of lathe, drilling machine and milling machines (No sketches of Machine tools, sketches to be used only for explaining operations. Students to be shown the machine tools in the Machine Shop).Application of Gears and simple Gear Trains in machine tools. Simple calculations related to simple gear train to find out the speed ratio, speed and direction of rotation of the driving or driven gear.

Robotics and Automation:

Robotics: Introduction, classification based on robots configuration, Polar, Cylindrical, Cartesian Coordinate and Spherical. Applications, Advantages and disadvantages.

Automation: Definition, types–Fixed, Programmable and Flexible automation, advantages and disadvantages of automation. **07 Hours**

List of Experiments:

1. Demonstration of fitting tools and processes.
2. Sheet metal development of 2 models (Prism and Pyramid).
3. Demonstration of welding process.
4. Metal joining processes using Soldering.
5. Studies on solar PV system .
6. Performance studies on Refrigeration systems.
7. Studies on Simple Gear Trains.
8. Studies on Valve and Port timing Diagrams.
9. Demonstration of Working Principle of Water Turbines.
10. Virtual Lab on Remotely Triggered Feedback Control of Robot for Pick and Place Operation and Trajectory Planning of Mobile Robot.

Note: : Mini-drafters and drawing boards are not required. Drawings (Developments) can be done on sketch sheets using scale, pencil and geometrical instruments.

Course Outcomes:

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

- Distinguish various applications of renewable and non-renewable energy resources.
- Categorize the various types of prime movers.
- Comprehend working of refrigeration and air-conditioning systems.
- Differentiate between various metal joining processes.
- Illustrate different machine tools, metal removal processes and the application of robots and automation.

Text Books:

1. V.K.Manglik: "Elements of Mechanical Engineering", (Chapters 2-8,10-14), PHI Publications, New Delhi, 1st Edition, 2014, ISBN: 978-81-203-4629-1.
2. MikellP. Groover: "Automation, Production Systems and CIM", (Chapter 5), PHI Publication, New Delhi, 3rd Edition, 2015, ISBN: 978-93-325-4981-4.

Reference Books:

1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy: "Elements of Mechanical Engineering", (Chapters 2,4,6,7,11,15,17,21-24,35), Media Promoters and Publishers Pvt. Ltd., Mumbai, 7th Edition, 2012, ISBN 13: 1234567145210.
2. S.K.Garg: "Workshop Technology (Manufacturing Processes)", (Chapters 5,7,8,19-21,26,29), University Science Press, Bangalore, 3rd Edition, 2013, ISBN: 978-81-318-0697-5.

3. C P Arora: "Refrigeration and Air Conditioning", (Chapters 1,3,4,12,23,24), Tata McGraw-Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2008, ISBN 13: 978-0-07-463010-5.
4. G.D.Rai: "Solar Energy Utilization", (Chapters 2,3,5,15,18), Khanna Publishers, New Delhi, 5th Edition, 2014, ISBN: 81-7409-134-X

E-Resources:

1. http://www.nptel.ac.in/downloads/112105127/
2. http://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2008/lecture-notes/
3. http://www.nptel.ac.in/downloads/112105125/
4. https://www.youtube.com/watch?v=pwoiMWCwkXQ
5. https://www.youtube.com/watch?v=bOPnzsdBoBU
6. http://iitg.vlab.co.in/?sub=62andbrch=271

Basic Electrical Engineering (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16ELE15/25	3:0:2:0	4	CIE:50 SEE:50	3 Hours	EFC

Course Objectives:

This course will enable students to :

- The fundamental concepts and techniques in electrical engineering.
- The concepts of domestic wiring.
- The functioning of various electrical apparatus and the safety measures at home and industry.
- The importance of transmission and distribution of electric power.

Syllabus

Module - I

DC Circuits: Ohm's law, Kirchhoff's current law, Kirchhoff's voltage law- applications of these law for the analysis of series, parallel and series parallel resistive circuits excited by independent voltage sources and illustrative examples. **08 Hours**

Module - II

Electromagnetism: Definitions of Magnetic force, flux, flux density, reluctance, magnetomotive force (mmf), emf. Faraday's Laws, Lenz's laws, Fleming's Rules, Statically and dynamically induced emf. Concept of self and mutual inductance and concept of coefficient of coupling. Energy stored in magnetic field and illustrative examples.

Domestic wiring: Two-way and three way position control switch. Necessity and types of earthing. Elementary discussion on fuses and circuit protective devices: fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock. **08 Hours**

Module - III

Single Phase A.C.Circuits: Generation of sinusoidal AC voltage, definition of average value, rms value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities. Analysis with phasor diagram of R,L, C, R-L, R-C, R-L-C circuits and series, parallel. Real power, reactive power, apparent power and power factor and illustrative examples. **08 Hours**

Module - IV

Transformers: Principle of operation and construction of single phase transformers (core and shell type). Emf equation, voltage regulation and its significance. Efficiency condition for maximum efficiency, power losses and illustrative examples.

Three Phase Circuits: Necessity and advantages of three phase systems, generation of three phase power. Definition of Phase sequence, balanced supply and balanced load. Relationship between line and phase values of balanced star and delta connections. Power in balanced three phase circuits, measurement of power by two-wattmeter method. Determination of power factor using wattmeter readings and illustrative examples. **08 Hours**

Module - V

DC and AC Machines: Electro-mechanical energy conversion machines, importance of DC machines, need for three phase synchronous generator, introduction to induction motors, concept of rotating magnetic field in induction motor, working principle of induction motors, construction of induction motors, slip and its importance and illustrative examples. **07 Hours**

List of experiments:

1. Verification of ohm's law.
2. Verification of Kirchhoff's law.
3. Verification of effective resistance between the terminal of series and parallel combination of resistors.
4. Verification of voltage and current distribution in both series and parallel circuits.

Study Experiments:

1. Study the characteristics of a Fluorescent tube.
2. Study experiment on domestic wiring and TWO way and THREE way control of a lamp.

Virtual Lab Experiments:

1. Analysis of current flowing in series and parallel RL circuit.
2. Analysis of current flowing in series and parallel RC circuit.
3. Analysis of current flowing in series and parallel LC circuit.
4. To plot the frequency and current characteristic of series and parallel RLC circuits.

Course Outcomes:

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

- Analyze the electrical circuits.
- Demonstrate simple domestic wiring involving two way and three way controls.
- Able to apply circuit's concept related to electrical engineering applications.
- Determine performance parameters of electrical apparatus and transformers.
- Use suitable motor for given application.

Text Book:

1. Kulshreshtha D.C: "Basic Electrical Engineering", (Chapters 1-5), McGraw - Hill Education, 1st Edition, 2012, ISBN 13: 9780071328968.

Reference Books:

1. Theraja. B.L: "Fundamentals of Electrical Engineering and Electronics", S.Chand and Company Ltd., Reprint Edition, 2013, ISBN 10: 8121926602.
2. Rajendra Prasad: "Fundamentals of Electrical Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2009, ISBN : 9788120339286.

E-Resources:

1. http://vlab.ambita.edu/index.php
2. http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105053
3. http://nptel.ac.in/syllabus/syllabus.php?subjectId=108108076
4. http://nptel.ac.in/courses/108108076/

Computer Programming Laboratory

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CPL16/26	1:0:2:0	2	CIE:50 SEE:50	3 Hours	EFC

Course Objectives:

This course will enable students to :

- The assembly of personal computer.
- The document processing softwares.
- The basic programming concepts.
- To trace and debug the program.

Syllabus

Part A

Demonstration of Personal Computer and its Accessories: Acquisition of knowledge on assembly of a Personal Computer. Loading of Operating Systems, Clairvoyant study through the observation of its demonstration.

Note: Students have to prepare a write-up on the same as part of laboratory record to be evaluated.

Laboratory Session: MS-Word: Creation of document, Applying different font styles and size, Text alignment, Line spacing, Bullets and numbering, Page borders, Working on tables, Insertion of Header and footer, use of format painter.

MS- Excel: Working on Tables, Simple formulas, working on charts.

MS- Power Point: Creating presentations using designs and Animations. Introduction to Flowchart and Algorithms.

Part B

1. Develop a flowchart that takes three coefficients (a, b, and c) of a Quadratic Equation ($ax^2+bx+c=0$) as input and compute all possible roots. Implement a C program for the developed flowchart and execute the same to output the possible roots for a given set of coefficients with appropriate messages.
2. Write an algorithm to find the reverse of an integer number and check whether it is PALINDROME or NOT. Implement a C program for the developed algorithm that takes a valid 4 digit integer as input and output the reverse of the same with suitable messages. Ex: Num: **2015**, Reverse: **5102**, Not a Palindrome.
3. Write a flow chart and an automated procedure to find the prime numbers below a given fixed integer. Realize the procedure through the execution of C program.
4. Draw the flowchart and write a recursive C function to find the factorial of a number, n! defined By 1!=0 and n! = n * (n - 1)! for a positive integer n. Using this function, write a C program to Compute the binomial coefficients of $(a + b)^n$ using ${}^nC_r$ for a given n.
5. Develop a C program that outputs the sequence of Fibonacci numbers below a given Integer.

6. Develop, implement and execute a C program that reads two matrices A (m x n) and B (p x q) and compute product of matrices A and B. Read matrix A and matrix B in row major order and in column major order respectively. Print both the input matrices and resultant matrix with suitable headings and output should be in matrix format only. Program must check the compatibility of orders of the matrices for multiplication and report appropriate message in case of incompatibility.
7. Write a flowchart and implement a C program using Euclid's algorithm to find the GCD and LCM of 2 integers.
8. Develop a C program that reads N integer numbers in random order and arrange them in Ascending/descending order as required using Bubble Sort technique.
9. Develop, implement and execute a C program to search a required integer number in an array of given numbers using Binary searching technique.
10. Write a C program to maintain a record of n student details using an array of structures with Four fields (Roll number, Name, Marks, and Grade). Assume appropriate data type for each field. Print the marks of the student, given the student name as input.

Scheme of Practical Examination:

Part A	-	10 marks
Part B	-	30 marks
Viva voce	-	10 marks
Total	-	**50 marks**

Note: Students have to conduct one experiment from each part.

Course Outcomes:

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

- Apply knowledge to identify various parts of computer.
- Develop problem solving skills using 'C'.
- Trace and debug the programs.
- Provide computer solutions to the society.
- Analyze problem in multiple ways.

Text Books:

1. E. Balaguruswamy: "Programming in ANSI C", Tata McGraw-Hill, India, 5th Edition, 2010, ISBN: 0070681821.
2. Vikas Gupta: "Computer Concepts and C Programming", Dreamtech Press, New Delhi, 2010, ISBN: 9789351194705.

Constitution of India, Professional Ethics and Human Rights

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CPH17/27	1:0:0:0	1	CIE:50 SEE:50	2 Hours	HSS

Course Objectives:

This course will enable students to :

- The basic information about Indian constitution.
- The fundamental rights and duties of a citizen.
- Special privileges of socially and economically weaker sections of the society.
- Individual role and ethical responsibility towards society.

Syllabus

Module - I

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution, Fundamental Rights and its limitations. **03 Hours**

Module - II

Directive Principles of State Policy and Relevance of Directive Principles of State Policy, Fundamental Duties. Union Executives – President, Prime Minister, Parliament, Supreme Court of India. **03 Hours**

Module - III

State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th and 91st Amendments. **02 Hours**

Module - IV

Special Provision for SC and ST, Special Provision for Women, Children and Backward Classes, Emergency Provisions. Human Rights- Working of National Human Rights Commission in India, Powers and functions of Municipalities, Panchayats and Co-operative Societies. **03 Hours**

Module - V

Scope and Aims of Engineering Ethics, Responsibility of Engineers, Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity and Reliability in Engineering. **02 Hours**

Course Outcomes:

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

- Familiarize with fundamental rights and duties.
- Recognize the Electoral Process.
- Get exposed to legislature and judiciary.
- Realize special provisions given for women, children and weaker section of society.
- Exhibit Engineering ethics and responsibilities of Engineers.

Text Books:

1. Durga Das Basu: "Introduction to the Constitution of India", Lexis Nexis Publications, 22nd Edition, 2015, ISBN-13: 978-9351434467.
2. Charles E. Haries, Michael S.Pritchard and Michael J. Robins: "Engineering Ethics", Thomson Wadsworth, 2nd Edition, 2003, ISBN-13: 978-9812436764.

Reference Books:

1. M.V.Pylee: "An Introduction to Constitution of India", Vikas Publishing, 2002, 1st Edition, ISBN-13: 978-8125918325.
2. M.Govindarajan, S.Natarajan, V.S.Senthilkumar: "Engineering Ethics", PHI Learning Private Limited, New Delhi, 2nd Edition, 2013, ISBN-13: 978-8120348165.
3. Brij Kishore Sharma: "Introduction to the Constitution of India", PHI Learning Private Limited, New Delhi, 7th Edition, 2015, ISBN-13: 978-8120350892.

E-Resources:

1. http://www.cgsird.gov.in/constitution.pdf
2. http://indiacode.nic.in/coiweb/welcome.html

Communication Skill Development

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16CSD18/28	1:0:0:0	1	CIE:50 SEE:50	2 Hours	HSS

Course Objectives:

This course will enable students to :

- The essentials of English grammar necessary for fluent and effective communication.
- The basics of communication and equip with introductory presentation skills.
- Subjects easily and effectively.

Syllabus

Module - I

Essentials of the Communication Process and its types: Introduction to communication, Benefits of good communication skills, The communication process; Ethical communication; Characteristics of a good communicator, Types of communication. **05 Hours**

Module - II

Basics of the English Language and its Grammar: History of English, English grammar: Words (Parts of speech, Spelling rules, Determiners, Paragraphs, Punctuation marks, Structure of a sentence, Basic sentence types), Classification of inflection, Forms of inflection, Inflection of nouns (Number, Gender), Inflection of verbs (Tense, Person, Voice), Inflection of adjectives (Degree). **06 Hours**

Module - III

Introduction to Etymology and Development of Vocabulary: Test Your Present Vocabulary (Word Power Made Easy), Etymology in English language, Start building your vocabulary (Word Power Made Easy), Personality Types (Word Power Made Easy). **05 Hours**

Module - IV

Common Errors in English Language : Categories of errors, Grammar error, Word choice error, Pronunciation error, Punctuation error, Spelling error, Test Your Grammar (Word Power Made Easy). **06 Hours**

Module - V

Presentation Skills: Introduction; Talking vs Presenting, The deadly sins, Overcoming nervousness, Attention and interest (Visual aids, Humor, Eye contact, Voice, Movement, Analogies, Human interest, Conviction and enthusiasm, Body language), Presentation steps. **06 Hours**

Course Outcomes:

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

- Comprehend the dynamics of communication.
- Develop the ability to participate in discussions and deliver presentations.
- Understand the basics of English grammar and identify common errors in English.
- Improve their vocabulary through the science of etymology.

Text Books:

1. Betty Schrampfer Azar: "Basic English Grammar", Pearson Longman, 3rd Edition, 2005, ISBN: 9780131849372.
2. David A Peoples: "Presentations Plus", John Wiley and Sons, 2nd Edition, 1992, ISBN-13: 978-0471559566.
3. Norman Lewis: "Word Power Made Easy", Penguin India, 1st Edition, 2015, ISBN-13: 978-0143424680.

Reference Books:

1. Raymond Murphy: "English Grammar in Use- A Self- study reference and practice book for intermediate learners of English", Cambridge University Press, 2012, ISBN-13: 978-1107670266.
2. Wren, Martin: "High School English Grammar and Composition", S Chand and Company, New Delhi, 2016, ISBN-13: 978-9352530144.
3. Nancy Duarte: "slide: ology", O'Reilly, 1st Edition, 2008, ISBN-13: 978-0596522346.

E-Resources:

1. http://www.mastersincommunication.com/public-speaking/
2. https://www.toastmasters.org/
3. https://www.ted.com/

Kannada Language

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16KAN19/29	1:0:0:0	Nil	SEE:100	2 Hours	MNC

Course Objectives:

This course will enable students to :

- The official language of the state of Karnataka.
- The language of the local people.

Syllabus

Module - I

Lesson 1 : Introducing each other – 1.
Personal Pronouns, Possessive forms, Interrogative words.
Lesson 2 : Introducing each other – 2.
Personal Pronouns, Possessive forms, Yes/No Type Interrogation.
Lesson 3 : About Ramayana.
Possessive forms of nouns, dubitive questions, Relative nouns.
Lesson 4 : Enquiring about a room for rent.
Qualitative and quantitative adjectives. **03 Hours**

Module - II

Lesson 5 : Enquiring about the college.
Predicative forms, locative case.
Lesson 6 : In a hotel.
Debatable cases, defective verbs.
Lesson 7 : Vegetable market.
Numeral, plurals.
Lesson 8 : Planning for a picnic.
Imperative, Permissive, hortative. **03 Hours**

Module - III

Lesson 9 : Conversation between Doctor and the patient.
Verb- iru, negation – illa, non – past tense.
Lesson 10 : Doctors advise to Patient.
Potential forms, no – past continuous.
Lesson 11 : Discussing about a film.
Past tense, negation.
Lesson 12 : About Brindavan Garden.
Past tense negation. **02 Hours**

Module - IV

Lesson 13 : About routine activities of a student.

Verbal Participle, reflexive form, negation.

Lesson 14 : Telephone conversation.

Past and present perfect past continuous and their negation.

Lesson 15 : About Halebeedu, Beluru. Relative participle, negation.

Lesson 16 : Discussing about examination and future plan.

Simple conditional and negative. **02 Hours**

Module - V

Lesson 17 : Karnataka (Lesson for reading).

Lesson 18 : Kannada Bhaashe (Lesson for reading).

Lesson 19 : ManataruvaSangatialla (Lesson for reading).

Lesson 20 : Beku Bedagalu (lesson for reading). **02 Hours**

Course Outcomes:

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

- Understand Kannada Language.
- Communicate in Kannada with local people.

Text Books:

1. Krishna Gopal Vikal: "Learn Kannada through English", Diamond Books, 2005, ISBN-13: 978-8128811876.
2. Kannada Kali Nali, Govt. of Karnataka, 1st to 3rd Std, 2011.

E-Resources:

1. http://www.xxandroid.com/d/kannada-kali-nali-textbook.html

Engineering Mathematics-II

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
16MAT21	4:0:0:4	5	CIE:50 SEE:50	3 Hours	BS

Course Objectives:

This course will enable students to understand:

- The application of mathematical skills in solving engineering problems.
- Tracing of curves by analyzing the function and fit the curves for the given data.
- The use of multiple integrals in finding area and volume of the different geometry.
- The applications of Laplace Transforms in engineering problems.

Syllabus

Module - I

Linear differential equations with constant coefficients: Solution of second and higher order differential equations –By inverse differential operator method, Method of variations of parameter. Initial value and boundary value problems. **10 Hours**

***Initial value and boundary value problems**

Module - II

Solution of simultaneous differential equations of first order. Linear differential equation with variable coefficients: Solution of Cauchy's and Legendre's Linear equations Application of Linear differential equations: Simple Harmonic motion ,simple pendulum. **10 Hours**

*** Application of Linear Differential Equations to LCR-Circuits.**

Module - III

Curve fitting by the method of least square: Straight line, parabola and exponential curves, rank correlation, Correlation and regression lines. Tracing of curves: Cartesian and polar forms. **10 Hours**

*** Tracing of curves in parametric form**

Module - IV

Multiple integrals: Evaluation of double and triple integrals . Evaluation of double integrals by changing the order of integration and changing into polar coordinates. Beta and Gamma functions: Definition, relations and simple problems. Applications of double and triple integrals to find area and volume. **10 Hours**

***Applications of double and triple integrals to find area and volume.**

Module - V

Definition, Laplace Transform(LT) of standard functions (Formula only), L.T of $e^{at} f(t)$ and $\frac{f(t)}{t}$ (Formula only)- Problems, L.T of periodic functions and unit step functions (No theorems).

Inverse Laplace Transforms: Inverse Laplace Transforms of the form $e^{-as}\overline{f}(s)$, completing square, partial fractions, logarithmic and inverse functions. solution of Liner Differential Equations using Laplace Transform. **10 Hours**

***Convolution Theorem - Problems**

Course Outcomes:

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

- Solve the higher order differential equations.
- Solve engineering problems by using differential equations.
- Fit the curve using given data.
- Use double and triple integrals to determine the area and volume.
- Find the Laplace and inverse transforms of the real value functions and solve the Initial Value Problems using Laplace transforms.

Text Books:

1. Dr. B.S. Grewal: "Higher Engineering Mathematics", (Chapters 4,7,13,14,21,24, 25), Khanna Publishers, New Delhi, 42nd Edition, 2012, ISBN: 9788174091956.
2. N.P. Bali and Dr. Manish Goyal: "A Text Book of Engineering Mathematics", (Chapters 5,7,9,11,12,30), Laxmi Publications (P) Ltd., New Delhi, 9th Edition, 2014, ISBN: 9788131808320.

Reference Books:

1. Erwin Kreyszig: "Advanced Engineering Mathematics"(Chapter: 2,3,6,10), Wiley Pvt. Ltd., India, New Delhi, 9th Edition, 2011, ISBN 13: 9788126531356.
2. B.V. Ramana: "Higher Engineering Mathematics" (Chapter: 2,6,13-15,18), Tata McGraw – Hill Publishing Company Limited, New Delhi, 2007, ISBN-13: 978-0-07-063419-0.
3. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", (Chapters 7-10,12-14,42,58,59), S. Chand and Company Private Limited, New Delhi, 3rd Edition, 2014, ISBN: 9788121938907.

E-Resources:

1. http://bookboon.com/en/essential-engineering-mathematics-ebook
2. https://www.free-ebooks.net/ebook/essential-engineering-mathematics

***Self Study topics to be studied by students and the students have to submit a report to the department.**

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