OVERALL CREDIT STRUCTURE AND

COURSE SYLLABI

FOR

UNDER GRADUATE PROGRAM

B.Tech. (Civil Engineering)
OVERALL CREDIT STRUCTURE

Undergraduate Core(UC)		Undergraduate Elective (UE)	
Category	*Credit*	*Category*	*Credit*
DC	67	**DE**	23 (minimum)
BS	19	**HM**	06 (minimum)
ES	22	**OC**	18 (Balance)
HM	05	**UN**	0 (03 Courses)
Total	113	**Total**	47
Grand Total (UC + UE)			**160**

Basic Science (BS)

Course Code	Course	L-T-P	Credit
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL251	Applied Mathematics-III*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)

Course Code	Course	L-T-P	Credit
HML151	Social Science	2-0-0	02
HMP152	Technical Communication	2-0-2	03
Total			**05**

Engineering Arts and Science (ES)

Course Code	Course	L-T-P	Credit
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
ECL151	Basic Electronics Engineering	3-0-0	03
ECP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	0-0-2	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	01
CEL151	Environmental Science	2-0-0	02
Total			**22**

Non Credit Requirement (UN)

Course Code	Course	L-T-P	Credit
NCN151	NCC#	-	0
NCN152	NSS#	-	0
NCN153	NSO#	-	0
SPB151	Sports-I#	0-0-4	0
SPB152	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
CET251	Practical Training	-	0

#A student has to opt at least one from NCC, NSS, NSO and Sports (I & II both).

Departmental Core (DC)

Course Code	Course	L-T-P	Credit
CEL251	Fluid Mechanics	3-0-0	3
CEP251	Fluid Mechanics Lab	0-0-2	1
CEL252	Engineering Geology	2-0-0	2
CEP252	Engineering Geology Lab	0-0-2	1
CEL253	Building Materials and Construction Technology	3-0-0	3
CEP253	Building Materials Testing Lab	0-0-2	1
CEL254	Environmental Engineering-I	3-0-0	3
CEP254	Environmental Engineering-I Lab	0-0-2	1
CEL255	Transportation Engineering	3-0-0	3
CEP255	Transportation Engineering Lab	0-0-2	1
CEL256	Surveying	3-0-0	3
CEP256	Surveying Lab	0-0-2	1
CEL257	Strength of Materials	3-2-0	4
CEL351	Geotechnical Engineering-I	3-0-0	3
CEP351	Geotechnical Engineering Lab	0-0-2	1
CEL352	Environmental Engineering-II	3-0-0	3
CEP352	Environmental Engineering-II Lab	0-0-2	1
CEL353	Structural Analysis	3-0-0	3
CEL354	Geotechnical Engineering-II	3-2-0	4
CEL355	Hydrology and Irrigation Engineering	3-2-0	4
CEL356	Indeterminate Structural Analysis	3-2-0	4
CEL357	Design of RCC Structure	3-2-0	4
CEL358	Design of Steel Structures	3-2-0	4
CEL359	Railway and Airport Engineering	3-0-0	3
CEL360	Estimation and Costing	3-0-0	3
CED351	Minor project	-	1
CED451	Major Project	-	2

Departmental Elective (DE)

Course Code	Course	L-T-P	Credit
SCL453	Probability Theory and Statistics	3-0-0	3
CEL451	Geomatics Engineering	3-0-0	3
CEP451	Geomatics Engineering Lab	0-0-2	1
CEL452	Non-Destructive Testing of Materials	3-0-0	3
CEP452	Non-Destructive Testing of Materials Lab	0-0-2	1
CEL453	Structural Dynamics	3-0-0	3
CEP453	Structural Dynamics Lab	0-0-2	1
CEL454	Design of Hydraulic Structures	3-2-0	4
CEL455	Rock Engineering	3-0-0	3
CEL456	Industrial Waste Management	3-0-0	3
CEL457	Environmental Impact and Risk Assessment	3-0-0	3
CEL458	Advanced Concrete Design	3-2-0	4
CEL459	River Mechanics	3-0-0	3
CEL460	Traffic Engineering	3-0-0	3
CEL461	Construction Planning and management	3-0-0	3
CEL462	Advanced Foundation Engineering	3-0-0	3
CEL463	Design of Prestressed Concrete Structures	3-0-0	3
CEL464	Urban Water and Environmental Management	3-0-0	3
CEL465	Advanced Structural Analysis	3-0-0	3
CEL466	Advanced Highway Engineering	3-0-0	3
CEL467	Groundwater Engineering	3-0-0	3
CEL468	Hydraulic and Hydraulic Machines	3-0-0	3
CEL469	Bridge Engineering	3-0-0	3
CEL470	Design of Earth Retaining Structures	3-0-0	3
CEL471	Architectural Planning and Design of Buildings	2-2-0	3
CEP481	RCC Structures Detailing Lab	0-0-2	1

Course Code: CEL151
Course Title: ENVIRONMENTAL SCIENCE
Structure (L-T-P): 2-0-0
Prerequisite: NIL
Contents: Eco System: Concept, Structure and functions; Biodiversity and its conservation. Sustainable development: definition, significant issues in the context of India, Environmental carrying capacity Environmental Pollution: Air, Water, Land, Noise etc., Pollution sources and effects, Pollution Prevention Strategies; Cleaner Technologies of Production, Principles of waste minimization, Global warming, greenhouse effect, acid rains. Solid waste management: Introduction to solid waste management, Sources, quantity and quality, Classification and components, Physical and chemical characteristics, Per capita contribution, Sampling and analysis. Collection and transportation of solid waste, Collection systems, Equipments used for collection and transportation, Transfer station. Composting of Waste: Principles of composting, factors affecting composting and methods of composting used in India. Social issues and the environment: Urban problems related to energy, Waste lands, Wetland and its reclamation, Nature, energy and water conservation, Rain water harvesting. Occupational health and safety: Introduction, Concept, Philosophy and Psychology of safety, Accident causes and prevention, Safety management, Risk identification, assessment and control techniques.

Text Book:

1. Dhameja, S.K., Environmental Engineering and Management, 2nd ed., S.K. Kataria and Sons, 2013.

Reference Books:

1. Nathanson J.A. and Schneider, R.A., Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 6th ed., Pearson Education, 2014.
2. Weiner R.F., Matthews, R.A. and Vesilind, P.A., Environmental Engineering 4th ed., Butterworth-Heinemann, 2003.
3. Sandhu R.S., Minhas, S.S. and Sandhu, J., Sustainable Human Settlements: The Asian Experience. Rawat Publication, 2001.
4. Pachauri, R.K., The Message from WSSD, The Energy and Resources Institute, 2003.
5. Rao, C.S., Envirmental Pollution Control Engineering, 2nd ed., New Age International, New Delhi, 2011.
6. Bhide, A.D., Sundaresan, Pollution Control Engineering, New Age International Pvt Ltd Publishers, 2002.
7. Ramesh R. Lakhe and Kranti P. Dharkar., ISO 45001:2018 Occupational Health & Safety Management System. 2018.

Course Code: CEL251
Course Title: FLUID MECHANICS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Properties of fluids, Hydrostatic forces on submerged bodies, Fundamentals of fluid flow, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks, flow measurement devices. Types of open channels, Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, Dimensional analysis and modeling similitude. Kinematics of flow. Concepts of boundary layer, flow separation, Circulation, Drag and lift on immersed bodies.

Text Books:

1. Fox, R.W. and McDonald, A.T., Introduction to Fluid Mechanics, John Wiley and Sons, 2013.
2. Subramanya, K., Flow in Open Channels, Tata McGraw Hill, 2008.
3. White F. M., Fluid Mechanics,7th edition, Tata McGraw Hill, 2013.

Reference Books:

1. Som, S.K. and Biswas, G., Fluid Mechanics and Fluid Mechanics, Tata McGraw Hill, 2013.
2. Garde, R.J. and Mirajgaoker, A.G., Engineering Fluid Mechanics, Nem Chand and Bros, 2002.
3. Srivastava, R., Flow through Open Channels, Oxford University Press, 2010.
4. Steeter, V.L., Wylie E.B. and Bedford, K.W., Fluid Mechanics, 9th edition., Tata McGraw Hill Education, 2011.

Course Code: CEL252
Course Title: ENGINEERING GEOLOGY
Structure (L-T-P): 2-0-0
Prerequisite: NIL
Contents: Introduction: Earth and its interior, role of engineering geology in planning, Design construction and post construction aspects of river valley projects and other civil engineering objects. Minerals and Rocks: Essential rock forming minerals, identification of common minerals in hand specimen. Types of rocks, texture and structures, importance in planning for construction in hills. Geological structures: Strike and dip of beds, Description and types of folds, joints, faults and shear zones as well as their importance in planning for civil structures. Weathering and soil formation: Types and agents of weathering – Mechanical and chemical weathering, impact of weathering on strength of slope materials, different soil types, soil map in India. Geological hazards: Earthquake and Landslides. River Valley Projects: Engineering geological considerations in river valley projects. Small hydro-electric projects. Roads and bridges in hills: Engineering geological investigations in selection of hill roads alignments, stability of cuts slopes, types of bridges, slope stability of abutment foundation.

Text Books:

1. Bell, F. G., Fundamentals of Engineering Geology, Elsevier, 2007.
2. Nagarajan,R., Parthasarathy, A. ,and Panchapakesan , V. , Engineering Geology 1st Edition

Reference Books:

1. Anbalagam, R., Singh B., Chakarborthy, D. and Kohli, A., A Field Manual for Landslide Investigation, DST, Government of India, New Delhi.
2. Singh, P., Engineering and General Geology, S.K. Kataria and Sons, 2012.
3. Krynine, D.P. and Judd, W.R., Principles of Engineering Geology and Geotechnics, Tata McGraw Hill, 2001.

Course Code: CEL253
Course Title: BUILDING MATERIALS AND CONSTRUCTION TECHNOLOGY
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Properties of construction materials and their evaluation (creep, elastic modulus, fatigue, impact, etc.); test methods and specifications; Cement – chemical composition, properties such as setting, strength, fineness, hydration; Aggregates – sources, properties, chemical reactivity; Concrete - constituents, proportioning, properties in fresh and hardened state, characteristic strength, quality control (sampling, acceptance, etc.), transportation and placing, porosity; Admixtures – chemical, mineral; Basics of concrete mix design. Steel – properties, types of steel, steel in civil engineering; Bricks – manufacture, properties and classification; masonry bonds; Brick masonry; bonds, stone masonry, types of walls, stairs, staircases, lifts and escalators. Shuttering, Scaffolding and Centering. Expansion and construction joints, sound and fire proof construction. Introduction to applications of Aluminum, glass and nano-materials in civil engineering.

Text Books:

1. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, 2013.
2. Kumar, S., Building Construction, Standard Publishers, 2010.

Reference Books:

1. Neville, A.M. and Brooks, J.J., Concrete Technology, ELBS Ed., Longman Ltd., 2013.
2. Taylor, G.D., Materials of Construction, Prentice Hall, 2012.
3. Dayaratnam, P., Brick and Reinforced Brick Structures, Oxford and IBH Publication, 2012.
4. Khanna, P.N., Indian Practical Civil Engineering Handbook, Engineers Publishers, 1988.

Course Code: **CEL254**
Course Title: **ENVIRONMENTAL ENGINEERING I**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Sources of Water, Water Quality, Water Demand: Types of demand and their contribution, rate of consumption, population forecasting, variation in demand pattern. Intakes structures for surface water source. Systems and unit processes of water Purification: Aeration, sedimentation, Coagulation and flocculation, filtration, Disinfection, Softening, Introduction to advanced water treatment methods. Conveyance of water: pipe materials, corrosion, laying of pipes, pumps for water supply, distribution system, planning of water supply projects. Rural water supply.

Text books:

1. Peavy, H.S., Rowe D.R. and Tchobanoglous, G., "Environmental Engineering", McGraw Hill. 1985.
2. Masters, G.,"Introduction to Environmental Engineering and Science". Prentice Hall. 2004.

Reference books:

1. Davis, M.L. and Cornwell, D.A., "Introduction to Environmental Engineering", McGraw Hill, 2012.
2. Kenneth, W., Warner, F.C. and Davis, W.T., "Air Pollution its Origin and Control", Prentice Hall, 1997.
3. S. K Garg.,"Water supply engineering: Environmental Engineering" Volume 1 Khanna Publications.
4. P.N Modi.,"Water supply engineering", Volume 1, Standard Publications.
5. McGhee, T.J., "Water Supply and Sewerage", McGraw Hill, 1991.

Course Code: **CEL255**
Course Title: **TRANSPORTATION ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Transportation modes and comparison, Role of transportation: Economic, Social, Political, Environmental. Historical Development, road patterns, master plans, road development plans, engineering survey for highway projects. Testing of road materials like soil, aggregates and bitumen. Highway Cross section elements, camber, super elevation, sight distances, horizontal and vertical alignment, summit and valley curves. Type of pavements, Flexible pavements and their design as per IRC 37, review of old methods, CBR method, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC 58 design method for rigid pavement. Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements, Construction of Rigid Pavements. Traffic characteristics, road user and vehicular characteristics, traffic studies, introduction to road traffic safety, traffic operations and traffic control devices; introduction to intelligent transport systems.

Text Books:

1. Khanna, S.K. and Justo, C.E.G., Highway Engineering, Nem Chand and Bros, 2011.
2. Kadiyali, L.R., Traffic Engineering and Transportation Planning, Khanna Publishers, 2012

Reference Books:

1. Sharma, S.K., Principles and Design of Highway Engineering, S. Chand and Co., 2012.
2. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall, 2008.
3. JotinKhisty, C. and Kent Lall, B., Transportation Engineering: An Introduction, Prentice Hall, 2008.
4. Khanna, S.K. and Justo, C.E.G., Highway Material Pavement Testing Manual, Nem Chand and Bros., 2013.
5. Roess, R.P., Prassas, E.S. and McShane, W.R., Traffic Engineering, Pearson, 2013.

Course Code: **CEL256**
Course Title: **SURVEYING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Importance of Surveying to engineering projects, basic principles; Type of maps, scales and uses, Plotting accuracy, map sheet numbering, Coordinate and map projection; Surveying equipment: levels, compass, theodolites, tachometer, EDM, Total Stations and other instruments; Measurement of angles, directions and distance; Determination of elevation: Spirit leveling, trigonometricalleveling, and tachometric surveying, Contouring; Methods of control establishment,: Traversing, triangulation, trilateration; Adjustment of survey measurements, computation of coordinates; Plane table surveys and mapping; Curve layout, Horizontal, transition and vertical curves. Introduction to Hydrographic Surveying, Photogrammetry, remote sensing, GIS and GPS.

Text Books:

1. Arora, K.R., Surveying, Vols. I, II and III, Standard Book House, 2013.
2. Chandra, A.M., Surveying, New Age International Publishers, 2010.

Reference Books:

1. Anderson, J.M. and Mikhail, E.M., Surveying: Theory and Practice, McGrawHill, 1988.
2. Schofield, W. and Breach M., Engineering Surveying, 6th ed., Butterworth- Heineman, 2007.

Course Code: **CEL257**
Course Title: **STRENGTH OF MATERIALS**
Structure (L-T-P): **3-2-0**
Prerequisite: **NIL**
Contents: Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Theories of failure, Mohr's circle. Bending moment and shear force diagrams for beams. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear center. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

Text Books:

1. Popov, E.P., Engineering Mechanics of Solids, 2nd Ed., Prentice Hall India, 2012.
2. Gere, J.M. and Timoshenko, S.P., Mechanics of Materials, 3rd ed., CBS Publishers and Distributors Pvt. Ltd., 2012.

Reference Books:

1. Beer, F.P., Johnston, E.R., Dewolf, J.T. and Mazurek, D.F., Mechanics of Materials, 5th ed., Tata McGraw Hill, 2011.
2. Shames, I.H., Introduction to Solid Mechanics, 3rd Ed., Prentice Hall India, 2006.
3. Crandall, S. H., Dahl, N.C., and Lardner. J., An introduction to the Mechanics of Solids., Tata McGraw Hill, 1978.

Course Code: **CEL351**
Course Title: **GEOTECHNICAL ENGINEERING - I**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Origin of soils; soil classification; Three-phase system: Physical Properties and their interrelationships, mechanical sieve analysis, consistency of fine grained soils, Atterberg's limits, relative density, Unified soil classification system, Indian system of

classification; Compaction: General principles, tests, factors affecting compaction, field compaction, compaction techniques; Capillarity and Permeability: Principles of total, effective and neutral stresses, field methods of permeability determination, equivalent permeability in stratified soils; Seepage Analysis: Darcy's law, 1-D flow, Laplace's equation, flow nets, seepage, uplift pressure, confined and unconfined flows, piping, filter criteria; Compressibility and Consolidation : Fundamentals, 1-D consolidation, normally and over consolidated clays, pressure - void ratio relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation; Shear Strength of Soil :Mohr stress circle representation, Mohr-Coulomb failure criterion, direct shear test, unconfined compression test, Triaxial compression test: consolidated drained, consolidated undrained, unconsolidated undrained tests, vane shear test, shear strength of clays and sands, critical void ratio, pore-pressure coefficients, sand drains.

Text Books:

1. Ranjan, G. and Rao, A.S.R., Basic and Applied Soil Mechanics, New Age International Publishers, 2012.
2. Gulhati, Shashi K., and Dutta. M, Geotechnical Engineering, Mcgraw Hill, 2015.
3. Craig, RF., Craig's Soil Mechanics, Taylor and Francis, 2010.

Reference Books:

1. Holtz, R.D. and Kovacs, W.D., An Introduction to Geotechnical Engineering, Prentice Hall, 2011.
2. Couduto, D.P., Geotechnical Engineering: Principles and Practices, Prentice Hall of India, 2007.
3. Murthy, V.N.S., Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers, 2011.
4. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley and Sons, 2008

Course Code: **CEL352**
Course Title: **ENVIRONMENTAL ENGINEERING II**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL254**

Contents: Sources of wastewater, Estimation of sanitary sewage flow, Estimation of storm runoff, Physical Chemical and Biological characteristics of wastewater and their significance, Effluent standards. Primary, secondary and tertiary treatment of wastewater.On-site systems, Sludge digestion, disposal of sludge. Disposal standards of effluents, self-purification of rivers, Streeter Phelps model and oxygen sag curve. Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Text Books:

1. Syed R. Qasim., "Wastewater Treatment Plants: Planning, Design, and Operation", Second Edition CRC press.
2. P.N Modi., "Sewage disposal and waste water engineering", 4th edition, Standard Publications.

Reference Books:

1. Metcalf., and Eddy., "Waste Water Engineering: Treatment and Reuse", T.M.H. Publication.
2. Kenneth, W., Warner, F.C. and Davis, W.T., "Air Pollution its Origin and Control", Prentice Hall, 1997.
3. S. K Garg, "Sewage disposal and Air pollution engineering", Volume II. Khanna Publications.
4. Masters, G., "Introduction to Environmental Engineering and Science", Prentice Hall, 2004.

Course Code: **CEL 353**
Course Title: **STRUCTURAL ANALYSIS**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL257**

Contents: Introduction to structures, loading and idealization. Internal forces in statically determinate structures– trusses, beams, frames, arches and cables. Deflection of statically determinate structures moment area method, conjugate beam method, unit load method. Strain energy method for slopes and deflections. virtual work method. Static and Kinematic indeterminacy of structures.Castigliano's theorems, theory of least work; Analysis of rolling loads. Influence lines for statically determinate structures.

Text Book:

1. Hibbeler, R.C., Structural Analysis, Pearson Press, 2013.

Reference Books:

1. William, F. R. et al., Mechanics of Materials, John Wiley and Sons. 2006.
2. Negi, L. S., and Jangid, R. S., Structural Analysis, Tata Mcgraw Hill Publication, 2004.
3. Reddy, C.S., Basic Structural Analysis, Tata McGraw Hill, 2012.
4. Norris, C. H., Wilbur, J. B. and Utku, S., Elementary Structural Analysis, Tata McGraw Hill. 1991.
5. West, H.H., Analysis of Structures, John Wiley and Sons, 2002.

Course Code: **CEL354**
Course Title: **GEOTECHNICAL ENGINEERING-II**
Structure (L-T-P): **3-2-0**
Prerequisite: **CEL351**

Contents: Sub-surface investigations- scope, soil boring techniques, sampling, penetration tests, plate load test. Foundation types: type, Foundation selection and design requirements; Shallow Foundations: bearing capacity, effect of shape, size, water table and other factors, stress distribution, settlement analysis in sands and clays, plate load test; Deep foundations: pile types, dynamic and static formulae, load capacity of piles in sands and clays, negative skin friction, pile group capacity, Methods of Stability of slopes: infinite slopes, finite slopes, method of slices, Swedish circle method, Friction circle method; Earth pressure theories, effect of water table, layered soils; Concept of rock mass; Rocks Mass classification systems.

Text Books:

1. Murthy, V.N.S., Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers, 2013.
2. Bowles, J.E., Foundation Analysis and Design, 1997, Tata McGraw Hill, 2013.

Reference Books:

1. Das, B.M., Principles of Geotechnical Engineering, Thomson, India, 2007.
2. Som, N.N. and Das, S.C., Theory and Practice of Foundation Design, Prentice-Hall, 2009.
3. Couduto, Donald P., Geotechnical Engineering: Principles and Practices, Prentice-Hall, 2007.
4. Peck, R.B., Hanson, W.E. and Thornburn, T.H., Foundation Engineering, John Wiley, 2012.

Course Code: **CEL355**
Course Title: **HYDROLOGY AND IRRIGATION ENGINEERING**
Structure (L-T-P): **3-2-0**
Prerequisite: **NIL**

Contents: Hydrologic cycle, rainfall: measurement of precipitation, Interpretation of precipitation data, estimation of missing data, test for consistency, Depth-Area-Duration analysis, rainfall estimation, methods of precipitation, abstraction from precipitation, evaporation, evapo-transpiration, infiltration: factors affecting infilteration, Horton's infiltration curve, phi-index, W-index, interception and depression storage, stage discharge relationships, flow-mass curve, flow-duration curve, Hydrographs: Different methods of drawing base-line for hydrographs, unit hydrograph

concept, derivation of UH, S-curve, construction of UH, derivation of average UH, flood estimation, reservoir capacity, reservoir and channel routing. Soil-water-plant relationships, wilting point and field efficiency, gross command area, irrigation efficiency, Duty, delta, Crop water requirements, consumptive use of water. Types of Irrigation system, Irrigation methods.Water logging and drainage, sodic soils.

Text Books:

1. Ojha, C.S.P., Berndtsson, R. and Bhunya, P., Engineering Hydrology, Oxford University Press, 2012.
2. Asawa, G.L., Irrigation and Water Resources Engineering, New Age International Publishers, 2013.
3. Subramanya, K., Engineering Hydrology, Tata McGraw Hill, New Delhi, 2013.

Reference Books:

1. Mysooru R., Yadupathi Putty, Principles of Hydrology, I K international publishing house, 2011.
2. Chow, V. T., Maidment, D.R. and Mays, L.W., Applied Hydrology, Tata McGraw Hill, 2013.

Course Code: **CEL356**
Course Title: **INDETERMINATE STRUCTURAL ANALYSIS**
Structure (L-T-P): **3-2-0**
Prerequisite: **CEL353**

Contents: Influence lines for statically indeterminate structures; Force method of analysis of indeterminate structures; Displacement approach: basic principles; Slope deflection method; Moment distribution method: frame with/without sway, use of symmetry and anti-symmetry; Matrix method: Flexibility and stiffness approach, Basic principles, Application to planar structures-trusses, beams and frames. Introduction to the space structures; Plastic analysis of beams and frames.

Text Books:

1. Pandit, G.,and Gupta, S., Theory of Structures (Vol. I & II), McGraw Hill, 1999.
2. Wang, C.K., Intermediate Structural Analysis, McGraw Hill, 2012.

Reference Books:

1. Hibbeler, R.C., Structural Analysis, Pearson Press, 2013.
2. William, F. R. et al., Mechanics of Materials, John Wiley and Sons, 2004.
3. Norris, C.H. et. al., Elementary Structural Analysis, Tata McGraw Hill, 1991.
4. West, H.H., Analysis of Structures, John Wiley and Sons, 2011.
5. Weaver, W. Jr. and Gere, J.M., Matrix Analysis of Framed Structures, CBS Publishers,2004.

Course Code: **CEL357**
Course Title: **DESIGN OF RCC STRUCTURES**
Structure (L-T-P): **3-2-0**
Pre-requisite: **CEL257, CEL353, CEL356**

Contents: Concrete Technology: properties of concrete, durability, creep, shrinkage, concrete mix design as per IS: 10262. Concrete design: basic working stress design concepts, working stress design for common flexural members; Limit state design of R.C. beam Sections in flexure, shear, torsion and bond; Design for serviceability; Design of one way and two-way R.C. Slabs; Cantilever and Continuous beams and slabs; Design of R.C. short and long columns; Design of R.C. footings; Design of staircase; Basic elements of prestressed concrete.

Text Books:

1. Pillai, S.U. and Menon, D., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Jain, A.K., "Reinforced Concrete" Nem Chand and Bros,2012.

Reference Books:

1. Sinha, S.N., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Subramanian, N., Design of Reinforced concrete Structures, Oxford Higher Education, 2014.
3. Shah, V.L. et. al., Limit State Theory and Design of Reinforced Concrete, Structures Publications, 2007.
4. Varghese, P.C., Limit State Design of Reinforced Concrete, Prentice-Hall,2011.
5. Park, R. and Pauley, T., Reinforced Concrete Structures, John Wiley and Sons, 2010.

Course Code: **CEL 358**
Course Title: **DESIGN OF STEEL STRUCTURES**
Structure (L-T-P): **3-2-0**
Prerequisite: **CEL257, CEL353, CEL356**

Contents: Introduction, properties of structural steel, I.S. rolled sections, I.S. specifications. Design approach, elastic method, limit state design. Connections, simple and moment resistant bolted and welded connections. Tension members.Compression members, struts and columns.Built-up columns, beams, stability of flange and web, built-up sections.Plate-girders including stiffeners, splices and curtailment of flange plates. Beam column, column bases, slab base, gusseted base and grillage footings.

Text Books:

1. Duggal, S.K., Limit State Design of Steel Structures, Tata McGraw-Hill, 2012.
2. Subramanian, N. Design of Steel Structures, Oxford University Press, 2012.

Reference Books:

1. Arya, A.S. and Ajmani, J.L., Design of Steel Structures, Nem Chand and Bros, 2007.
2. Gaylord, E. H., Design of Steel Structures, Tata McGraw Hill India, 2008.
3. Dayaratnam, P., Design of Steel Structures, S. Chand Publisher, 1998.

Course Code: **CEL359**
Course Title: **RAILWAY AND AIRPORT ENGINEERING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**

Contents: History of Indian Railways, universal scenario and Indian railways, railway track development, component parts, gauge, wheel and axle arrangement. Various resistances and their evaluation, hauling capacity, tractive effort, locomotives and their classification, stresses in the track and its components. Rails and their requirements, creep and wear in rails, rail joints, long welding rails and short welded rails, types of sleepers and their merits and demerits, requirements of ballast, design of ballast section, track fastenings, check rails and guard rails, railway cross-section, various types of gradients, design of horizontal curves, transition curves and vertical curves, existing provisions on IR. Working and design of a turnout, types of track junctions, design of crossover and diamond crossing, types of signals and their functions, interlocking, advanced methods of train control. High speed rails. Scenario of air transport in India, national and international agencies, aircraft characteristics, site selection, airport obstructions, imaginary surfaces.Runway orientation, geometric design of runway, taxiway, exit taxiway, apron, holding apron, runway configuration, visual aids.

Text Books:

1. Chandra, S. and Agarwal, M.M., Railway Engineering, Oxford University Press, New Delhi, 2013.
2. Arora, S. P. and Saxena, S.C, A Text book on Railway Engineering, DhanpatRai Publications Pvt. Ltd., New Delhi, 2006.
3. Saxena, S. C., Airport Engineering: Planning and Design, CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2008.

Reference Books:

1. Mundrey, J. S., Railway Track Engineering, Tata McGraw Hill Publishing, 2009.
2. Khanna, S. K., Arora, S. P. and Jain, S. S., Airport Planning and Design, Nem Chand and Bros, Roorkee, 1999.

Course Code: **CEL360**
Course Title: **ESTIMATION AND COSTING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**

Contents: Estimates: Types, complete set of estimate, working drawings, site plan, layout plan, index plan, plinth area administrative approval and Technical Sanction. Estimate of buildings, Estimate of R.C.C. works, White washing, colour washing, painting, and distempering, plastering and pointing. Types of roofs, floors and foundations, damp proofing, Doors and windows. Estimate of sloped roof and steel structures, Estimate of water supply and sanitary works, Estimates of roads (a) Earthwork (b) Bridges and culverts c) Pavement, Estimate of Irrigation works. Analysis of Rates: For earthwork, concrete works, D.P.C., Brickwork, stone masonry, plastering, pointing, road work, carriage of materials. Specifications: General specification for different classes of building, detailed specifications for various Civil Engineering Works.

Text Books:

1. Chakraborti, M., Estimating and Costing, 2002.
2. Dutta, B. N., Estimating and Costing in Civil Engineering, UBS Publishers and Distributors Ltd., New Delhi, 1999.

Reference Books:

1. Birdie, G.S., Estimating and Costing, DhanpatRai and Sons, 1994.
2. Kohli, D. D., Kohli, R.C., Estimating and Costing, S. Chand and Company, New Delhi, 2004.

Course Code: **CEL451**
Course Title: **GEOMATICS ENGINEERING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CEL256**

Contents: Introduction of Geomatics Engineering; Photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement, Stereoscopy, Measurement of parallax and height determination; Basic remote sensing, interaction mechanism with atmospheric and earth surface, platforms and sensors, remote sensing data products, visual data interpretation for information extraction; Digital Image, introduction to digital image processing, pre-processing, enhancement, classification; Introduction of Geographic Information System (GIS), GIS database, raster and vector data structure, digital elevation model; Introduction to GPS surveys, space, control and user segments, GPS receivers; Applications of Geomatics to various projects.

Text Books:

1. Agarwal, C.S. and Garg, P.K. Remote Sensing in Natural Resources Monitoring and Management, Wheeler Publishing House, New Delhi, 2000.
2. Lillesand, T.L., and Kiefer, R.W., Remote Sensing and Image Interpretation, 4th ed., John Wiley and Sons, 2005.

Reference Books:

1. Ghilani, C.D. and Wolf, P.R. Elementary Surveying: an Introduction to Geomatics, Pearson, 2012.
2. Bossler, J.D. Manual of Geospatial Science and Technology, Taylor and Francis, London, 2002.
3. Burrough, P.A. and McDonnell, R.A. Principles of Geographic Information System, Oxford University Press, 2000.
4. Chandra, A.M. and Ghosh, S.K. Remote Sensing and Geographical Information Systems, Alpha Science, Oxford U.K., 2005.
5. Gopi, S. Global Positioning System: Principles and Applications, TataMcGraw Hill, 2005.
6. Lo, C.P. and Yeung, A.K.W. Concepts and Techniques of Geographical Information System, Prentice Hall, India, 2002.

Course Code: **CEL452**
Course Title: **NON-DESTRUCTIVE TESTING OF MATERIALS**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CEL253**

Contents: Types of materials, tests and the variables involved, destructive and non-destructive testing correlation of properties obtained by NDT with the basic structure of matter and other properties; NDT of different materials by various techniques such as radiographic, sonic and ultrasonic, electrical and magnetic, soleoroscopic, microwave, eddy current penetrant, thermal optical, holographic etc., practical applications and advances in NDT.

Text Books:

1. Bungey, S., Lillard, G. and Grantham, M.G. Testing of Concrete in Structures, 4th Ed. Taylor and Francis, London.
2. Malhotra, V.M. and Carino, N.J., Handbook on Non-Destructive Testing of Concrete, 2nd Ed., Taylor and Francis, London.

Reference Books:

1. Krautkramer, H., Ultrasonic Testing of Materials, Springer-Verlag, 1969.
2. Novgoresky, M.A., Testing of Building Materials and Structures, Mir Publishers, 1973.
3. American Society of Metals: Handbook, Vol. II, Destructive Inspection and Quality Control, 1976.

Course Code: **CEL 453**
Course Title: **STRUCTURAL DYNAMICS**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL353**

Contents: SDOF System: Equation of motion; Free vibration; Harmonic load; Evaluation of damping,; Periodic load; General load (time domain, frequency domain); Response spectrum load, Transmissibility and base isolation. MDOF Systems: Structural matrices; Un-damped free vibration; damped free vibration, undamped forced vibration and damped force vibration. Generation of damping matrix Rayleigh damping model, Mode superposition analysis; Practical considerations.Introduction to earthquake resistant design.

Text Books:

1. Chopra, A. K., Dynamics of Structures, Applications to Earthquake Engineering, Prentice Hall, 2000.
2. Clough, R. W. and Penzien, J., Dynamics of Structures, 2nd ed., Tata McGraw Hill, Singapore, 1993.

Reference Books:

1. Meirovitch, L., Elements of Vibration Analysis, 2nd edition, Tata McGraw Hill, Singapore, 1986.
2. Agarwal, P. and Shrikhande, M., Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., 2006.
3. James, L.S, Manual of Seismic Design, Pearson Education, 2004.

Course Code: **CEL454**
Course Title: **DESIGN OF HYDRAULIC STRUCTURES**
Structure (L-T-P): **3-2-0**
Prerequisite: **CEL251**

Contents: Design of lined and unlined canals, Kennedy and Lacey theory, Types of dams, Gravity dam: various forces, site-selection, modes of failure, stresses, design, elementary and practical profile, low and high gravity dams, construction methods. Spillways: Types and classification of spillways, selection of spillways, special types of spillways, Canal: design of canals & Canal Regulation structures, canal fall and its types, design of Sarda type canal falls, Canal Outlets and regulation works, types of outlet, criteria for outlet behavior, flexibility, sensitivity, setting, cross-drainage structures, Design of weirs on permeable foundation. Introduction to hydro-mechanical and electro-mechanical structures.

Text Books:

1. Fuentes C., Chavez C. , Irrigation engineering and hydraulic structures, Magnum publishers, 2016.
2. Sharma S. K., Irrigation engineering and hydraulic structures, S. Chand, 2016

Reference Books:

1. Modi, P.N., Introduction to Water Resources and Waterpower Engineering, Standard Publication, Delhi, 2013.
2. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2013.
3. Asawa, G. L., Irrigation and Water Resources Engineering, New Age International Publishers, 2013.
4. Varshney, R. S., Gupta S.C. and Gupta R.L., Theory and Design of Irrigation Structures, Vol. I and II, Nem Chand and Bros. 2007.

Course Code: **CEL455**
Course Title: **ROCK ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL252**

Contents: Rock forming minerals and rock types: rock mass; classification systems for rocks and rock masses: RMR, Q system, strength and deformation behavior of rocks, strength and failure criteria for rocks and rock masses, strength of rock joints, laboratory and field testing of rocks, measurement of in-situ stresses; Foundations on rocks: bearing capacity theories, IS code methods, Foundation treatment for dams, barrages, bridge piers etc; Stability of rock slopes: Stereographic projections, modes of failure, stability of plane, wedge and toppling failures, protection measures; Ground conditions in tunneling, Stress distribution around circular tunnels, various support systems, tunnel orientation.

Text Books:

1. Goodman P.E., Introduction to Rock Mechanics, John Wiley and Sons, 1999.
2. Ramamurthy, T., Engineering for rocks: Foundations, Slopes and Tunnels, IBH Publication, 2003.

Reference Books:

1. Brown, E.T., Rock Characterisation Testing and Monitoring, Pergaman Press, 1991.
2. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering, Oxford and IBH Publication, 1991.
3. Hock, E. and Bray, J., Rock Slope Engineering, Institute of Mining and Metallurgy, 1991.
4. Singh, Bhawani, Goel, R. K., Engineering Rock Mass Classification, Elsevier, 2012.
5. Singh, Bhawani, Goel, R. K., Tunnelling in Weak Rocks, Elsevier Science, 2006.

Course Code: **CEL456**
Course Title: **INDUSTRIAL WASTE MANAGEMENT**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL 254, CEL 352**

Contents: Industrial Wastewater nature and characteristics, Environmental Impacts, Regulatory Requirements, Prevention vs Control of Industrial Pollution, Source Reduction Techniques , Waste Minimization, Equalization, Neutralization, Adsorption, Aerobic and Anaerobic Biological Treatment, Sequencing Batch Reactors, Chemical Oxidation, Ozonation, Photo catalysis, Ion Exchange, Membrane Technologies, Zero Effluent Discharge Systems, Wastewater Reuse, Disposal of Effluent on Land, Wastewater Characteristics and Wastewater Treatment for Textiles, Tanneries, Pulp and Paper, Pharmaceuticals, Food Processing and Dairy industries. Solid Waste Management: Characteristics, generation, collection and transportation of wastes, reuse/recycle, energy recovery, treatment and disposal.

Text books:

1. Rao, M.N. and Dutta, A.K., "Wastewater Treatment", Oxford-IBH Publication, 1995.
2. Freeman, H.M., "Industrial Pollution Prevention Hand Book", McGraw Hill Inc., New Delhi, 1995.

Reference Books:

1. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw Hill Book Company, New Delhi, 2000.
2. Shen, T.T., "Industrial Pollution Prevention", Springer, 1999.
3. Stephenson, R.L. and Blackburn, J.B., "Industrial Wastewater Systems Hand Book", Lewis Publishers, New York, 1998.
4. Bishop, P.L., "Pollution Prevention: Fundamental and Practice", Tata McGraw Hill, 2000.
5. Peavy, H.S., Rowe D.R. and Tchobanoglous, G., "Environmental Engineering", McGraw Hill. 1985.

Course Code: **CEL457**
Course Title: **ENVIRONMENTAL IMPACT AND RISK ASSESSMENT**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL 254, CEL 352**

Contents: Introduction and scope, utility of the EIA Process, expended and narrowed scope of EIA, Impacts of development activities, planning and management of impact studies. Environment attributes, environmental indices and indicators, environmental assessment, methods and techniques, matrices, network and checklist methods. Prediction technique for quality of environmental attributes. Impact evaluation, assessment of impact on air, water, soil and ground water, noise, biological environment.Assessment of impact on socio- economic environment, evaluation methods, mitigation measures. Health risk assessment, hazard identification toxicology and dose response characterization, exposure characterization, risk characterization, uncertainty in estimates. Risk evaluation, risk acceptance, basic principles of health risk management.

Text book:

1. Jain, P. K., "Environment Impact Assessment", John Wiley and Sons, 1978.
2. Paustenbach, D.A., "Risk Assessment: A Text Book of Case Studies", John Wiley and Sons, 1992.

Reference Books:

1. Kenneth, W., Warner, F.C. and Davis, W.T., "Air Pollution its Origin and Control", Prentice Hall, 1997.
2. Mishra, P.C., "Fundamental of Air and Water Pollution", South Asia Books, 1990.
3. Masters, G., "Introduction to Environmental Engineering and Science", Prentice Hall, 2004.

Course Code: **CEL458**
Course Title: **ADVANCED CONCRETE DESIGN**
Structure (L-T-P): **3-2-0**
Pre-requisite: **CEL357**

Contents: Design of Reinforced Cement Concrete Structures: Building frames static and dynamic analysis and component design, provisions of ductile detailing; Liquid retaining structures; Earth retaining walls; Flat slabs; Design of bridge: standard specifications and general design considerations; Industrial Structures: Analysis and design of Cylindrical shell structures, Folded plates, Chimneys, Silos, Bunkers.

Text Books:

1. Raju, N. Krishna, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2013.
2. Victor D.J, Essential of Bridge Engineering, Oxford and IBH Publication, 2007.

Reference Books:

1. Sinha, S.N., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Shah, V.L. et.al., Limit State Theory and Design of Reinforced Concrete, Structures Publications, 2007.
3. Nilson, A.H., and Winter, G., Design of Concrete Structures, McGraw Hill, New Delhi, 1983.
4. Varghese, P.C., Advanced Reinforced Concrete Design, Prentice-Hall, 2nd edition, 2005.

Course Code: **CEL459**
Course Title: **RIVER MECHANICS**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL251**

Contents: Introduction, River morphology, drainage patterns, stream order. Properties of mixture of sediment and water,

incipient motion and quantitative approach to incipient motion, channel degradation and armoring. Bed forms and resistance to flow, various approaches for bed load transport, suspended load profile and suspended load equations, total load transport including total load transport equations. Comparison and evaluation of sediment transport equations. Stable Channel design with critical tractive force theory.

Text Book:

1. Garde, R.J. and Ranga, Raju K., Mechanics of Sediment Transportation and Alluvial Stream Problems, New Age International Publishers, 2000.

Reference Books:

1. Yang, C. T., Sediment Transport: Theory and Practice, Tata McGraw Hill, New Delhi, 1996.
2. Henderson, F. M., Open Channel Flow, MacMillan, New York, 1996.
3. Chang, H. H., Fluvial Processes in River Engineering, John Wiley and Sons, 1988.
4. Simons, D. B. and Senturk, F., Sediment Transport Technology, Water Resources Publications, Fort Collins, Colorado, 1977

Course Code: **CEL460**
Course Title: **TRAFFIC ENGINEERING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CEL255**
Contents: Traffic Engineering and Characteristics: Importance and scope of traffic engineering, traffic characteristics, human factors governing road user characteristics, vehicular characteristics. Fundamentals of Traffic Flow: Traffic flow elements, time-space diagram, flow-density relationship, gap and gap acceptance. Traffic Studies: Type of studies, Traffic Volume Study – Applications, Methods of data collection, Volume data analysis, Peak Hour concept, Volume to capacity ratio, concepts and application of AADT, DDHV, Temporal expansion factors, Passenger Car Units, Volume data presentation; Traffic Speed Study - Applications, Methods of data collection, Time and Space Mean Speeds, Speed characteristics based on frequency and density functions, Fit of Normal distribution to the data, Before and After study; Capacity Analysis – Service volumes and saturation flows, Factors affecting lane capacity. Parking Study – Parking characteristics, Parking Accumulation analysis, Parking demand and supply analysis, Parking Duration analysis, Parking angles and estimation of parking spaces; Accident Study and Analysis – Causes of accidents, Collision and Condition diagrams, Safety Audit and Remedial measures. Traffic Calming Techniques, Traffic Volume and Speed calming, Road pricing, Regulations related to road users.

Text Book:

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, 6th ed., KhannaPublishers, 2012

Reference Books:

1. McShane, W.R. and Roess, R.P., Traffic Engineering, Prentice Hall, 2010.
2. Papacostas, C. S. and Prevedouros, P.D., Fundamentals of Transportation Engineering, Prentice Hall, 2001.

Course Code: **CEL461**
Course Title: **CONSTRUCTION PLANING AND MANAGEMENT**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Engineering Economics: Cash flow diagram, Time value of money, Inflation, Interest, Depreciation, Present worth and capitalized cost, Equivalent uniform annual cost and rate of return evaluations, Benefit cost analysis, Analysis of variable costs, Types of capital financing, Valuation. Tendering and Contract: Organisational structure, Methods of tendering, Specifications, Conditions of contract, Contract law, Disputes and Arbitrations. Construction Planning and Management: Time, Cost and Research management of projects for planning, Scheduling, Control and forecasting using networks with CPM/PERT. Personnel, Material and Finance Management, Safety Engineering. Construction Equipments: Selection, Planning and Cost, Equipments, Earthmoving, Excavating, Hauling, Compacting, Drilling and Blasting, Grouting, Conveying and Dewatering Equipments. Aggregate Cement Concrete and Asphatt Concrete Plants.

Text Books:

1. Srinath, L.S., PERT and CPM: Principles and Applications, East West Press, New Delhi, 2013.
2. Sengupta, B. and Guha, H., Construction Management and Planning, Tata McGraw Hill, New Delhi, 1998.

Reference Books:

1. Moder, J.J. and Phillips, C.R., Project Management with CPM and PERT, Van Nostrand Reinhold,1983.
2. Pilcher, R., Appraisal and Control of Project Cost, 1973.
3. Jebsen, J., Cost and Optimisation Engineering, Tata McGraw Hill, New York.

Course Code: **CEL462**
Course Title: **ADVANCE FOUNDATION ENGINEERING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CEL351, CEL354**
Contents: Shallow Foundations: Empirical methods, Layered soils, Foundations under eccentric and inclined loads, Foundations on or near slopes; Pile Foundations: Pile load tests, load capacity of laterally loaded piles, Settlement of piles in cohesion-less soils; Caissons/Well foundations: Types and components, Various loads and load combinations, Methods of stability analysis, Codal provisions, Construction methods; Machine Foundations: Single degree freedom system, Free and forced vibrations, Machine foundations: Types of machines and machine foundations, Design criteria, Dynamic Elastic Constants, Block vibration and cyclic plate load tests, Design of block foundations; Earth Retaining Structures.

Text Books:

1. Das, B.M., Principles of Foundation Engineering, PWS Publishing, 1998.
2. Bowles, J.E., Foundation Analysis and Design, Tata McGraw Hill, 2013.
3. Murthy, V.N.S., Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers, 2011

Reference Books:

1. Tomlinson, Michael, and John Woodward. Pile design and construction practice. CRC Press, 2014.
2. Som, N.N. and Das, S.C., Theory and Practice of Foundation Design, Prentice Hall, 2006.
3. Couduto, Donald P., Geotechnical Engineering: Principles and Practices, Prentice Hall, 2010.
4. Peck, R.B., Hanson, W.E. and Thornburn, T.H., Foundation Engineering, John Wiley and Sons, 1974.
5. Saran, S., Soil Dynamics and Machine Foundations, Galgotia Publication, 1979.

Course Code: **CEL463**
Course Title: **DESIGN OF PRESTRESSED CONCRETE STRUCTURES**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CEL357**
Contents: Introduction to basic concepts and general principles of pre-stressed concrete, materials used in prestressed concrete and methods and techniques of prestressing, prestressing systems. Analysis of prestressed concrete sections for flexure considering loading stages, computation of sectional properties, critical sections under working loads for pretensioned and post tensioned members, load balancing method of analysis of prestressed concrete beams, losses in prestress, application to simply supported beams and slabs. Design philosophy of prestressed concrete sections, permissible stresses in concrete and steel, design approaches using working stress method as per IS 1343 – 1980, limit state of collapse – flexure and shear as applied to prestressed concrete beams, kern points, choice and efficiency of sections, cable profile and layouts, cable zone, deflection of prestressed concrete sections. End zone stresses in prestresses concrete members, pretension transfer bond, transmission length, end block of post tensioned members. Design of simply supported pre-tensioned and post tensioned slabs and beams.Design of bridge girders as per IRC.

Text Book:

1. Raju, N. Krishna, Prestressed concrete, CBS Publishers and Distributors, fifth edition, 2017

Reference Books:

1. Lin, T. Y., & Burns, N. H., Design of prestressed concrete structures, 1981.
2. Park, R., Design of Prestressed Concrete Structures. University of Canterbury, 1977.

Course Code: **CEL464**
Course Title: **URBAN WATER AND ENVIRONMENTAL MANAGEMENT**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**

Contents: Review of Urban Hydrologic and Hydraulic Principles: Urban hydrologic cycle, rainfall analysis and design storm, hydraulic and hydrodynamic principles Introduction to Drainage Problems in Different Climate: Urbanization - its effects and consequences for drainage, Interaction between urban and peri-urban areas. Planning concepts and System Planning: Objectives of urban drainage and planning criteria, drainage option and system layout, Planning tools and data requirement, Drainage master plan, Drainage structures Calculation Methods and Mathematical Tools: Modeling formulas, Hydrologic models, Hydrodynamic models, Regression analysis, Urban runoff and water quality models Design of Drainage System Elements: Hydraulic fundamentals, Infiltration and on-site detention of storm water, Design of sewerage and drainage channels, design of appurtenances and pumping stations Control of Storm water Pollution: Pollution bid-up and wash off process with reference to urban drainage systems, Source control in commercial and Industrial complexes, Biological and chemical treatment of waste water, Best management practices Operation and Maintenance of Urban Drainage Systems: Maintenance requirements and planning, Cleansing of sewers and drains, repair options Administrative and Legal Aspects and Financing: Administrative, legal and financing aspects, International, national and municipal legal aspects, Administrative structure for drainage planning, Financing for drainage projects.

Text Books:

1. Akan, A.O., "Urban Stormwater Hydrology: A Guide to Engineering Calculations", Lancaster Technomic, 1993.
2. Larry, W.M, "Stormwater Collection Systems Design Handbook", Tata McGraw Hill, New York, 2001.

Reference Books:

1. Strickland, G., "Urban Hydrology for Small Watersheds", NTIS, Springfield, 1975.
2. Deb, R.," Municipal Stormwater Management", Lewis Publishers, 1995.
3. Hittman Associates," Approaches to Stormwater Management", NTIS, Springer, 1973.
4. Hall, M.J., "Urban Hydrology", Elsevier, London, 1984.

Course Code: **CEL465**
Course Title: **ADVANCED STRUCTURAL ANALYSIS**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL353, CEL356**

Contents: Review of basic concepts of structural analysis, Basis for principle of virtual work, Principle of virtual forces - standard and matrix formulation; Force method for analyzing skeletal structure; Principles of virtual displacements - standard and matrix formulation; Displacement method for analyzing skeletal structures; Extension of displacement method to the generalized stiffness method; Basic concepts associated with computer implementation of stiffness method. One dimensional beam element: Basis for cross-sectional level formulation of flexibility and stiffness, Flexibility approach for determining element stiffness; Stiffness approach for determining element stiffness; Formulation of geometric stiffness due to axial force;. Introduction to finite element method.

Text Book:

1. Kanchi, M.B. Matrix Methods of Structural Analysis. John Wiley & Sons, 1982

Reference Books:

1. Weaver, W., and Gere, James, Matrix Analysis of Framed Structures, CBS Publishers, 2004.
2. Pandit and Gupta. Structural Analysis by Matrix Approach. McGraw Hills, 1994.

Course Code: **CEL466**
Course Title: **ADVANCED HIGHWAY ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL255**

Contents: Introduction: National road development programmes, IRC Vision-2021 and Rural Road Vision-225,New Road Materials : Alternate forms of aggregates, theory and specifications of fillers, additives, emulsions, cutbacks and modified binder, Mix designs - Marshall, Hubbard Field and Hveem Method, requirement of a mix, Cold mix design.Design of Flexible and Rigid Pavements: Design factors, empirical, semi-empirical and analytical design methods, California bearing ratio, triaxial, Mcleod and, design considerations for expressways. Rigid Pavements : Design factors, load and temperature stresses, load transfer devices, design of Dowel and Tie bars, joint requirement and working, IRC methods of design of pavements.Stabilized Roads: Aggregate mixtures, proportioning, types of stabilizations, advantages and limitation, special problems related to drainage, control of seepage and capillary rise, importance and functions of each layer of pavement and subgrade.Pavement Evaluation Techniques for Functional and Structural Evaluation: Benkalman beam deflection method, flexible and rigid overlays. Maintenance of Pavements: Routine and periodic maintenance, special repairs, maintenance management system, case study of failure of flexible and rigid pavements cracking, settlement, frost heaving and mud pumping in pavements. Construction Project Management: Construction industry; construction project; product development process; project management ; main causes of project failure; BOT, BOOT, BORT and other variants of BOT. causes of introducing this system, Liberalization policies of GOI for these system; GOI, state governments, other local bodies, board, corporation etc are adopting these system for construction project management.

Text books:

1. Kadiyali, L.R. and Lal, N.B., "Principles and Practices of Highway Engineering", Khanna Publishers, 2006.
2. Wright, P. H. and Dixon, K.K., "Highway Engineering", John Wiley, 2004.

Reference books:

1. Kerbs, R.D. and Walker. R.D. "Highway Materials" , McGraw Hill, 1971.
2. Khanna, S.K. and Justo, C.E.G. "Highway Engineering" Nem Chand and Bros. 2001.
3. Huang, Y.H. "Pavement Analysis and Design" Prentice Hall, 1993.
4. Indian highways – a framework for commercialization by Gajendra Haldia.

Course Code: **CEL467**
Course Title: **GROUNDWATER ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL251**

Contents: Aquifer: various types, properties, permeability, specific yield, transmissivity , storage coefficient and methods of estimation, Introduction to Well hydraulics, objectives of Groundwater hydraulics, Darcy's Law, Groundwater equation, steady state flow, Dupuit-Forchheimer's assumption, groundwater quality management and its development, recharge techniques and groundwater conservation.

Text Books:

1. Bear J. and Alexander Cheng, Modeling groundwater flow and contaminant transport, Springer Publishers, Volume 23, 2010.
2. Todd D. K., Groundwater Hydrology, John Wiley and Sons, 2005.
3. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998

Reference Books:

1. Agarwal V. C., Groundwater hydrology, Prentice Hall Publisher, 2012.
2. William C. Walton, Principles of Groundwater engineering, Lewis, 1st edition, 1990

Course Code: **CEL468**
Course Title: **HYDRAULIC AND HYDRAULIC MACHINES**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL251**

Contents: Hydraulics: Introduction to open channel flow, laminar flow, Turbulent flow: velocity distribution, turbulent flow in circular pipes, resistance of smooth and artificially roughened pipes, resistance diagram. Hydraulic Machines: Introduction to hydraulic machineries, installation and working principle, Turbines: classification of turbines: Pelton, Francis and Kaplan turbines, effective head and water power, jet ratios and bucket dimensions, velocity triangles, characteristic curves, draft tubes, efficiency of turbines, unit and specific speeds, performance curves of turbines, Pumps: classification, centrifugal and reciprocating pump, cavitation, velocity triangles, unit and specific speeds, characteristics curves, , performance curves, efficiency and power generation, Multiple-stage pumps.

Text Books:

1. Rajput R. K., A textbook of Hydraulic Machines, S Chand, 6th edition, 2016.
2. Pati S., Textbook of Fluid mechanics and hydraulic machines, Tata McGraw Hill, 2017.

Reference Books:

1. Som, S.K. and Biswas, G., Fluid Mechanics and Fluid Mechanics, Tata McGraw Hill, 2013.
2. Fox, R.W. and McDonald, A.T., Introduction to Fluid Mechanics, John Wiley and Sons, 2013.

Course Code: **CEL469**
Course Title: **BRIDGE ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL357**

Contents: Introduction: Definition, components of a bridge, classifications, importance of bridge, Investigation of Bridges: Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, scour depth, choice of bridge type. Standard Specifications: For road bridges, I.R.C. loadings, code provisions on width of carriage way, clearances, loads considered etc. standard specifications for railway bridges, Railway bridge code. Reinforced Concrete Design of culvert, T-beam bridge, Courbon's theory for load distribution, pre-stressed concrete bridges (General discussions). Sub Structure: Types of piers and abutments, design forces, design of piers and abutments. Bearing and Joints: Various types of expansion bearing and fixed bearings, elastomeric bearings, joints and their types.

Text Book:

1. Victor D. J. "Essentials of Bridge Engineering" Oxford and IBH Publishers, New Delhi, 6th edition 2017.

Reference Books:

1. Hambly E. C, "Bridge Deck Behaviour", E & FN Spon Publications, 2nd edition 1991.
2. Raina, V. K. "Concrete Bridge Practice, Analysis, Design and Economics", Tata McGraw- Hills Publishing Company Limited, 2014.
3. Ryall M.J., Parke G.A.R, Harding J.E., "The Manual of Bridge Engineering", Thomas Telford Publishers, 2000.
4. Rajagopalan R., "Bridge Superstructure", Tata McGraw- Hills Publishing Company Limited, 2nd edition 2006.
5. Ponnuswamy S., "Bridge Engineering", Tata McGraw - Hills Publishing Company Limited, 5th edition 2015.
6. Aswani M. G., Vazirani V.N., Ratwani M. M., "Design of Concrete Bridges", Khanna Publishers, 2014.

Course Code: **CEL470**
Course Title: **DESIGN OF EARTH RETAINING STRUCTURES**
Structure (L-T-P): **3-0-0**
Prerequisite: **CEL351, CEL354**

Contents: Earth retaining structures: Types, material, method of construction, nature of forces acting, comparison of different earth pressure theories and application in retaining wall, stability analysis and design aspects; Reinforced soil retaining walls: General aspects, Design and analysis - External stability of vertically faced reinforced soil retaining wall. Internal stability – Tie back wedge analysis or coherent gravity analysis or reinforced soil retaining walls with metallic strip and continuous geosynthetic reinforcements. Sheet Pile wall: Types, materials used in construction, free earth system, fixed earth system, selection of soil parameters, analysis and design of cantilever and anchored sheet pile walls, dead man and continuous anchor, diaphragm and bored pile walls; Braced excavations: Earth pressure against bracings in cuts, heave of the bottom of cut in soft clays; reinforced earth retaining structures, design of earth embankments and slopes; arching and open cuts, recent advances in Earth retaining structures.

Text Book:

1. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992.
2. Koerner, R.M., Designing with Geosynthetics, Prentice Hall, New Jersey, USA, 4th edition, 1999.

Reference Books:

1. Das, B. M., Principles of Foundation Engineering, Thomson, Indian Edition, 2003.
2. Bowles, J. E., Foundation Analysis and Design. McGraw-Hill International Edition, 1997.
3. Jones, C.J.F.P., Earth reinforcement and soil structures. Butterworth, London, 1985.
4. SivakumarBabu, G.L., An introduction to Soil reinforcement and geosynthetics. United Press (India) Pvt. Ltd. 2006.

Course Code: **CEL471**
Course Title: **ARCHITECTURAL PLANNING AND DESIGN OF BUILDINGS**
Structure (L-T-P): **2-2-0**
Prerequisite: **NIL**

Contents: Planning principles of buildings, Typical Building Byelaws as per National Building Code and General Development Control Regulation, Planning of residential building, Planning of public buildings, and industrial building, Orientation of buildings, Built Environment, Functional planning: lightning, heating, ventilation, climate factors. Building services, circulation, plumbing, electrification and sanitation. Layout: residential, auditoria, cinema hall, studio etc. Introduction to town planning. Computer aided small and full-fledged architectural design works.

Text Books:

1. Singh, G., Building Planning Designing and Scheduling, Standard Publishers Distributors, 2009.
2. Spence, W.P., Architectural Working Drawings: Residential and Commercial Buildings, John Wiley & Sons, 1993.

Reference Books:

1. Kaleem, S., Zaidi A. &Siddiqui S., Drawing & Design of Residential & Commercial Buildings, Standard Publishers Distributors, 2nd Edition, 2013.
2. SP 7: Group 1: National Building Code of India (Group 1), 2005.

B. Tech. (Computer Science and Engineering)

OVERALL CREDIT STRUCTURE

Undergraduate Core (UC)		Undergraduate Elective (UE)	
Category	***Credit***	***Category***	***Credit***
DC	67	**DE**	23 (minimum)
BS	19	**HM**	06 (minimum)
ES	22	**OC**	18 (Balance)
HM	05	**UN**	0 (03 Courses)
Total	113	**Total**	47
Grand Total (UC + UE)			**160**

Basic Science (BS)

Course Code	Course	L-T-P	Credit
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL253	Probability and Numerical Methods*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)

Course Code	Course	L-T-P	Credit
HMP152	Technical Communication	2-0-2	03
HML151	Social Science	2-0-0	02
Total			**05**

Engineering Arts and Science (ES)

Course Code	Course	L-T-P	Credit
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
ECL151	Basic Electronics Engineering	3-0-0	03
ECP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	0-0-2	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	01
CEL151	Environmental Science	2-0-0	02
Total			**22**

Non Credit Requirement (UN)

Course Code	Course	L-T-P	Credit
NCN151	NCC#	-	0
NCN152	NSS#	-	0
NCN153	NSO#	-	0
SPB151	Sports-I#	0-0-4	0
SPB152	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
CST251	Practical Training	-	0

#A student has to opt at least one from NCC, NSS, NSO and Sports (I & II both).

Departmental Core (DC)

Course Code	Course	L-T-P	Credit
CSL251	Data Structures	3-0-0	03
CSP 251	Data Structures Lab	0-0-2	01
CSL252	Operating Systems	3-0-0	03
CSP 252	Operating Systems Lab	0-0-2	01
CSL253	Object Oriented Design	3-0-0	03
CSP 253	Programming Lab	0-0-2	01
CSL254	Design and Analysis of Algorithms	3-0-0	03
CSP 254	Algorithms Lab	0-0-2	01
CSL255	Computer Networks	3-0-0	03
CSP 255	Computer Networks Lab	0-0-2	01
CSL256	Software Engineering	3-0-0	03
CSP 256	Software Lab	0-0-2	01
CSL257	Data Communication	3-0-0	03
CSL258	Computer Organization	3-0-0	03
CSL259	Theory of Computation	3-0-0	03
CSL351	Database Management Systems	3-0-0	03
CSP 351	DBMS Lab	0-0-2	01
CSL352	Compiler Design	3-0-0	03
CSP 352	Compiler Design Lab	0-0-4	02
CSL353	Data Science	3-0-0	03
CSP 353	Python Lab	0-0-2	01
CSL354	Information and Network Security	3-0-0	03
CSL355	Artificial Intelligence	3-0-0	03
SCL254	Discrete Mathematics	3-2-0	04
ECL256	Digital Circuits	3-0-0	03
ECP256	Digital Circuits Lab	0-0-2	01
ECL353	Microcontroller and Interfacing	3-0-0	03
ECP353	Microcontroller and Interfacing Lab	0-0-2	01
CED351	Minor Project	-	01
CED451	Major Project	-	02

Departmental Elective (DE)

Course Code	Course	L-T-P	Credit
CSP354	Network Security Lab	0-0-4	02
CSP355	Artificial Intelligence Lab	0-0-4	02
CSL356	Digital Image Processing	3-0-0	03
CSP356	Embedded Systems Lab	0-0-4	02
CSL357	Web Technologies	3-0-0	03
CSL358	Information Retrieval	3-0-0	03
CSL359	Neuro-Fuzzy Techniques	3-0-0	03
CSL360	Computer Graphics	3-0-0	03
CSL451	Real Time Systems	3-0-0	03
CSP451	Real Time Systems Lab	0-0-4	02
CSL452	Cloud Computing	3-0-0	03
CSP452	Cloud Computing Lab	0-0-6	03
CSL453	Internet of Things	3-0-0	03
CSP453	IoT Lab	0-0-6	03
CSL454	Machine Learning	3-0-0	03
CSP454	Machine Learning Lab	0-0-6	03
CSL455	Parallel and Distributed Computing	3-0-0	03
CSP455	Linux Lab	0-0-6	03
CSL456	Multimedia Technologies	3-0-0	03
CSL457	Concepts in Blockchaining	3-0-0	03
CSL458	Cyber Forensic	3-0-0	03
CSL459	System Programming	3-0-0	03
CSL460	Fundamental Algorithms in Computational Biology	3-0-0	03
ECL355	Digital Communication Systems	3-0-0	03
ECP355	Digital Communication Systems Lab	0-0-2	01
ECL357	Information Theory & Coding	3-0-0	03
ECL468	Embedded System Design	3-0-0	03

Course Code: CSL151
Course Title: COMPUTER PROGRAMMING AND PROBLEM SOLVING
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Overview of a computer system, Block diagram and major parts of a computer, history of computer development, introduction to binary, octal, & hexadecimal numbers, ASCII code, different levels of programming languages – machine language, assembly language, high level language; need of operating system, tree structure of storage, introduction to assembler, compiler and interpreter.
Introduction: Flow charts, data types and storage classes, scope of variables, arithmetic operators, assignment, conditional, arithmetic expressions, enumerated data types, decision making, branching, looping, Switch concept, function and parameter passing, recursive functions, macros. Basic programming algorithms: Programs to illustrate basic language constructs in C like - Factorial, Sine/cosine and other mathematical series, Fibonacci series, calculating square-root of a number, calculating GCD of 2 integers (Euclid's method and otherwise), Calculating LCM of 2 integers and similar such programs. Arrays and applications: Introduction to one dimensional and 2-D array with examples. Representing a polynomial using 1-D array and polynomial operations, Use of 2-D array to represent a matrix and matrix operations. Character arrays (strings): String related functions (strlen, strcpy, strcat, strcmp, reverse etc.) and their function definitions. Searching and Sorting methods: Selection sort, Bubble sort, Insertion sort, Linear and binary search, partitioning an array, merging of 2 sorted arrays. Structures and Unions: Basic concept, array of structures and its applications.
Pointers: Introduction (declaration and initialization), pointers and arrays, concept of dynamic memory allocation, use of pointers to represent variable-sized 1-D and 2-D arrays, pointers to structures.
File Management in C: Open, close, read and write operations, Sequential and text files.
Text Books:
1. Kerninghan, B.W. And Ritchie, D.M., The C Programming Language, 2nd ed., PHI, Delhi, 2012.
2. Balguruswamy, E., Programming in ANSI C, 6th ed., Tata McGraw Hill, New Delhi, 2013.

Reference Books:
1. Deshpande, P.S. and Kakde, O.G., C and Data Structures, Dreamtech Press, New Delhi, 2009.
2. Dromey, R.G., How to Solve it by Computer, Pearson Education, Delhi, 2008.
3. Gottfried, B.S., Schaum's Outline of Theory and Problems of Programing with C, 2nd ed., McGraw Hill, New York, 2007.

Course Code: CSL251
Course Title: DATA STRUCTURES
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Types and operations, Iterative constructs and loop invariants, Structured Programming and modular design, Illustrative examples, recursion, program stack and function invocations including recursion. Overview of arrays and array based algorithms - searching and sorting, Overview of Selection sort, bubble sort and insertion-sort, Divide and Conquer – Merge sort, Quicksort, Binary search, Introduction to Program complexity (Big Oh notation), Recurrence relations. Sparse matrices. Introduction to pointers, scope rules, parameter passing mechanisms – pass by value and pass-by-reference. Structures (Records) and array of structures (records). Database implementation using array of records. Dynamic memory allocation and de allocation. Dynamically allocated single and multi-dimensional arrays. Files, operations on them, examples of using file. Stack, Queues and its operations. Concept of an Abstract Data Type (ADT), Implementation of stacks and queues using both array-based and pointer-based Structures. Uses of stacks in simulating recursive procedures/ functions. Applications of stacks and queues. Lists – Self-referential structures, Singly-linked lists, doubly linked lists and circular linked lists. List traversal, insertion, deletion at different positions in the linked lists, concatenation, list-reversal etc. Merge sort for linked lists. Applications of lists in polynomial representation, multi-precision arithmetic, hash-tables etc. Multi linked structures and an example application like sparse matrices. Implementation of priority queues. Trees , binary trees, binary trees- basic algorithms and various traversals. Binary Search Trees (BSTs) and insertion, deletion in BSTs.Height-balanced (AVL) trees, insertion/deletion and rotations. Heaps and heap sort. Multi-way trees and external sorting –Introduction to B-trees and B+trees. Tries. Applications of the above mentioned trees. Generalisation of trees to graphs – Introduction to DFS, BFS and Topological sort.
Text Books:
1. Kruse, R.L., Tondo, C. L. and Leung, B.P., Data Structures and Program Design in C, 2nd ed., Pearson Education, Delhi, India, 2013.
2. Horowitz, E., Sahni, S. and Anderson-Freed, S., Fundamentals of Data Structures in C, 2nd ed., University Press, Hyderabad, 2012.

Reference Books:
1. Kerninghan, B.W. and Ritchie, D.M., The C Programming Language, 2nd ed., PHI, Delhi, 2012.
2. Dromey, R.G., How to Solve it by Computer, Pearson Education, Delhi, 2008.

Course Code: CSL252
Course Title: OPERATING SYSTEMS
Structure (L-T-P): 3-0-0
Pre-requisite: CSL251
Contents: Introduction, basic h/w support necessary for modern operating systems - Services provided by OS, system programs and system calls – brief discussions of evolution of OS- real time and distributed systems: a brief overview of issues.
File systems, user interface - disk space management and space allocation strategies- examples from UNIX, DOS, Windows, etc. – directory structures- disk caching- file system consistency and logs-disk arm scheduling strategies. Processes and 3 levels of scheduling - process control block and context switch - goals of scheduling and different scheduling algorithms- threads: user-level and kernel level. Memory management techniques - contiguous and non-contiguous-paging and segmentation - translation look-aside buffers (TLB) and overheads - virtual memory and demand paging- page faults and instruction restart - problems of large address spaces - page replacement algorithms and working sets - miscellaneous issues. Process cooperation and synchronization - mutual exclusion and implementation - semaphores, conditional critical regions and monitors - classical inter - process communication problems-message passing. Deadlocks and strategies for handling them. Protection and security issues - access lists, capabilities, cryptographic techniques - introduction to distributed systems.
Text Books:
1. Silberschatz, A., Galvin, P.B. and Gagne, G., Operating System Concepts, 8th ed., Wiley, 2014.
2. Stallings, W., Operating Systems: Internals and Design Principles, 7th ed., Pearson, 2014.

Reference Books:
1. Crowley, C., Operating Systems: A Design-Oriented Approach, Tata McGraw Hill, 2001.
2. Tanenbaum, A.S., Modern Operating Systems, 3rd ed., Prentice Hall of India, 2014.

Course Code: CSL253
Course Title: OBJECT ORIENTED DESIGN
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Object Oriented Programming, Features of object oriented programming languages like data encapsulation, inheritance, polymorphism and late binding. Concept of a class,

Access control of members of a class, instantiating a class, static and non-static members, overloading a method.
Deriving a class from another class, access control of members under derivation, different ways of class derivation, overriding of a method, run time polymorphism.
Concept of an abstract class. Concept of an interface. Implementation of an interface.
Exception and exception handling mechanisms. Study of exception handling mechanisms in object-oriented languages
Introduction to streams, use of stream classes. Serialization and de-serialization of objects.
Templates, Implementation of data structures like linked lists, stacks, queues, trees, graphs, hash table etc. using object oriented programming languages. Introduction to concept of refactoring, modeling techniques like UML, Design patterns.

Text Books:

1. Arnold K., Gosling J. and Holmes, D., The Java Programming Language, 3rd ed., Pearson Education, 2013.
2. Weisfeld, M.A.,The Object-Oriented Thought Process, 3rd ed., Pearson, 2013.

Reference Books:

1. Stroustrup, B., The C++ Programming Language,4th ed., Addison-Wesley,2014
2. Schildt, H., C++: The Complete Reference, 5th ed., McGraw-Hill, 2012.
3. Cox, B.J. and Novobilski, A.J., Object-Oriented Programming: AnEvolutionary Approach, 2nd ed., Addison Wesley, 1993.

Course Code: **CSL254**
Course Title: **DESIGN AND ANALYSIS OF ALGORITHMS**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CSL251**
Contents: Mathematical foundations, summation of arithmetic and geometric series, n, n2, Bounding summations using integration, recurrence relations, solutions of recurrence relations using technique of characteristic equation and generating functions.
Asymptotic notations of analysis of algorithms, analyzing control structures, worst case and average case analysis, amortized analysis, sorting algorithms such as selection sort, insertion sort, bubble sort, heap sort, lower bound proof, elementary and advanced data structures with operations on them and their time complexity.
Divide and conquer basic strategy, binary search, quick sort, merge sort, Fast Fourier Transform etc. Greedy method - basic strategy, application to job sequencing with deadlines problem, minimum cost spanning trees, single source shortest path etc.
Dynamic Programming basic strategy, multistage graphs, all pairs shortest path, single source shortest paths, optimal binary search trees, traveling salesman problem.
Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queen‘s problem, graph coloring, Hamiltonian cycles etc. NP-hard and NP-complete problems, basic concepts, nondeterministic algorithms, NP-hard and NP-complete, Cook‘s Theorem, decision and optimization problems, polynomial reduction.

Text Books:

1. Cormen, T.H., Leiserson, C.E. and Rivest, R.L., Shamir, Introduction to Algorithms, 3rd ed., PHI Learning Private Ltd., 2013.
2. Horowitz, E., Sahni, S. and Rajasekaran, S., Fundamentals of ComputerAlgorithms, 2nd ed., University Press, 2012.

Reference Books:

1. Brassard, G. and Bratley, P., Fundamentals of Algorithmics, PHI Learning Private Limited, 2008.

Course Code: **CSL 255**
Course Title: **COMPUTER NETWORKS**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CSL254**
Contents: Introduction to Network Architecture, Layering and Protocols, Internet Architecture Topologies, Transmission Media (Guided and Unguided), Performance, Bandwidth and Latency, Encoding (Unipolar, Polar, Bipolar), Data Transmission, Multiplexing and De-Multiplexing, Framing, Error Detection and Correction Techniques, Line Discipline, Flow Control, and Error Control, Bit stuffing and Corrector Stuffing, Byte-Oriented Protocols (PPP), Bit-Oriented Protocols (HDLC), internetworking (IEEE 802.1), LLC (IEEE 802.2), MAC (IEEE 802.3), Token Bus (IEEE 802.4) and Token Ring (IEEE 802.5), FDDI, Switching (Circuit Switching and Packet Switching), Point-to-Point Protocol(PPP), Link Control Protocol(LCP). Routing, Bridging, Gateway, Brouters, Routing Protocols (Distance Vector (RIP), Link State (OSPF). IP Addressing (Classful and Classless), Masking, Subneting and Superneting, ARP and RARP, Host Configuration (DHCP), 1Pv4, IPv6, UDP, TCP. Connection Establishment and Termination, Triggering Transmission, Adaptive Retransmission Error Reporting (ICMP, IGMP), Presentation layer functions, Electronic Mail (SMTP, MIME, 1MAP), World Wide,
Web(HTTP), Web services multimedia applications, Session control and call control, SDP, SIP, H.323, Name service (DNS), Network Management(SNMP).

Text Books:

1. Peterson, L.L. and Davie, B.S., Computers Networks: A Systems Approach, 5th ed., Elsevier, 2013.
2. Forouzan, B.A., Data Communications and Networking, 5thed.Tata McGraw- Hill, 2013.

Reference Books:

1. Tanenbaum, A. S. and Wetherall, D., Computer Networks, 5th ed., Pearson, 2014.
2. Haykin, S.S. and Moher, M., Communication Systems, 5th ed., John Wiley and Sons, 2012.
3. Comer, D., Computer Networks and Internets, 6th ed., Pearson, 2014.
4. Kurose, J.F. and Ross, K.W., Computer Networking: A Top-Down Approach, 6th ed., Pearson Education, 2013.
5. Stallings, W., Data and Computer Communications, 10th ed., Pearson Education, 2014.

Course Code: **CSL256**
Course Title: **SOFTWARE ENGINEERING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CSL253**
Contents: Introduction to Software Engineering, software Characteristics, software life-cycle models, process models, software project management, software configuration management, software requirements specifications, software architecture, software design function-oriented software design, object-oriented design, UML modeling, user interface design, software implementation, software testing, verification and validation, Software Quality Frameworks, ISO 9001 Model, SEI-CMM Model, Software reliability and fault-tolerance, software metrics.

Text Books:

1. Pressman, R.S. and Maxim, B.R., Software Engineering: A Practitioner‘s Approach, 8th ed., McGraw Hill, 2014.
2. Sommerville, I., Software Engineering, 9thed.,Pearson Education 2013.

Reference Books:

1. Singh,Y.,Software Testing, Cambridge University Press, 2013.

Course Code: **CSL257**
Course Title: **DATA COMMUNICATION**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CSL151**
Contents: Introduction to data communication and networking, OSI and TCP/IP protocol suit, Analog and Digital signals, Digital transmission, Analog transmission, Multiplexing (Frequency division Multiplexing, Wavelength division Multiplexing, Time division Multiplexing, Multiplexing applications), transmission media (Guided Media, Unguided Media, Transmission Impairments, Performance Wavelength , Shannon Capacity , Media Comparison, PSTN , Switching), Error Detection and Correction, DTE-DCE Communication (Digital data transmission, DTE-DCE Interface, Modems, 56K Modems , Cable Modems), Encoding (NRZ, NRZI, Manchester, Differential Manchester, 4B/5B), Clock based framing, Integrated services digital network (ISDN), Introduction to networks.

Text Books:

1. Data communication & Networking by Bahrouz Forouzan.
2. Computer Networks by Andrew S. Tanenbaum.

3. Forouzan, B.A., Data Communications and Networking, 5thed.Tata McGraw- Hill, 2013.

Reference Books:

1. Stallings, W., Data and Computer Communications, 10th ed., Pearson Education, 2014.

Course Code: CSL258
Course Title: COMPUTER ORGANIZATION
Structure (L-T-P): 3-0-0
Pre-requisite: NIL

Contents: Addressing methods, their application in implementation of HLL constructs and data structures, instruction formats, expanding op-code method, subroutine linkage. Instruction sets of ARM, Intel and Motorola Processors. Processing unit, bus architecture, execution of a complete instruction, sequencing of control signals, micro programmed control, microinstruction format, microinstruction sequencing, bit slice concept. Arithmetic, number representations and their operations, design of fast address, signed multiplication, Booth's Algorithm, bit-pair recording, division, floating point numbers and operations, guard bits and rounding.

Main memory organization, various technologies used in memory design, higher order memory design, multi module memories and interleaving, cache memory, concept of cache memory, mapping functions, replacement algorithms.

Input-output organization, I/O mapped I/O and memory mapped I/O, Direct Memory Access, interrupt and interrupts handling mechanisms, device identification, vectored interrupts, interrupt nesting, I/O interfaces, synchronous vs. asynchronous data transfer, I/O channels. Computer peripherals, I/O devices such as video terminals, video displays, graphic input devices, printers, magnetic disk, magnetic tape , CDROM systems.

Introduction to RISC philosophy, Pipelining, Basic concepts in pipelining.

Text Book:

1. Hamacher, V.C., Vranesic, Z.G. and Zaky, S.G., Computer Organization, 5th ed., Tata McGraw Hill, 2013.

Reference Books:

1. Patterson, D.A.and Hennessy, J.L., Computer Organization and Design: The Hardware/Software Interface, 5th ed., Morgan Kaufmann, Amsterdam, 2014.
2. Stallings, W., Computer Organization and Architecture: Designing for Performance, 9th ed., Pearson Education, Boston, 2013.
3. Tanenbaum, A.S. and Austin, T., Structured Computer Organization, 6th ed., Pearson Education, 2013.

Course Code: CSL259
Course Title: THEORY OF COMPUTATION
Structure (L-T-P): 3-0-0
Pre-requisite: CSL251

Contents: Preliminaries - Sets, operations, relations, transitive closure, countability and diagonalisation, induction and proof methods- pigeon-hole principle and simple applications- concept of language- grammars and production rules- Chomsky hierarchy. Regular grammars, deterministic finite automata - non determinism, conversion to deterministic automata-e-closures, regular expressions, finite automata, regular sets. Pump lemma for regular sets- closure properties of regular sets, decision properties for regular sets, minimization of automata. Context - free languages, parse trees and ambiguity, reduction of CFGS, Chomsky and Griebach normal forms, push - down Automata (PDA), non-determinism, acceptance by two methods and their equivalence, CFLs and PDAs – Pumping lemma for context free languages, Closure and decision properties of CFLs. Timing machines– variants, recursively enumerable (r. e.) sets, recursive sets, TM as computer of function, decidability and solvability, Halting Problem, reductions, Post correspondence Problem (PCP) and insolvability of ambiguity problem of CFGs.

Introduction to recursive function theory - primitive recursive and partial recursive functions Church-Turing thesis- convergence of viewpoints of what computability is: Semi formal treatment.

Text Book:

1. Martin, J.C., Introduction to Languages and the Theory of Computation, 3rded., Tata McGraw Hill, 2014.

Reference Book:

1. Hopcroft, J.E., Motwani, R. and Ullman, J.D., Introduction to AutomataTheory, Languages and Computation, 3rd ed., Pearson Education, 2014.

Course Code: CSL351
Course Title: DATABASE MANAGEMENT SYSTEMS
Structure (L-T-P): 3-0-0
Pre-requisite: CSL252

Contents: Database system concepts and Architecture - concept of relational database, Relational data model, Relational algebra, SQL-the relational database standard, ER and EER model.

Database design theory - Functional dependencies and normalization, relational database design algorithms, practical database design and demoralization, Relational constants, programmatic ways for implementing constraints, triggers, Chase algorithm.

Physical database design - Concept of physical and logical hierarchy, storage structures like cluster, index organized table, partitions, various table storage Parameters and block storage parameters, concept of index, B-trees, hash index, Function index, bitmap index. Process and memory management in database- Various types of tasks in database, database buffer management, log buffer management code reuse, concept of two tier and N-tier architecture, data dictionary and catalog information database recovery technique. Arier Algorithm for recovery. Query optimization and performance tuning- Various techniques for query optimization, strong and weak equivalence, cost base optimization, Use of different storage structures in query optimization.

Transaction Processing - Transaction and system concepts, Desirable properties of transaction, Schedules and recoverability, serializability of schedules, concurrency control, lock base protocols and time stamp based protocols, read consistency.

Text Book:

1. Silberschatz, A.,Korth, H.F. and Sudarshan, S.Database System Concepts, 6th ed., Tata McGraw-Hill, 2011.

Reference Books:

1. Elmasri, R.A. and Navathe, S.B., Fundamentals of Database Systems, 6th ed., Pearson Education, 2014.
2. Ullman, J.D., Principles of Database Systems, 2nd ed., Computer Science Press, 1990.

Course Code: CSL352
Course Title: COMPILER DESIGN
Structure (L-T-P): 3-0-0
Pre-requisite: CSL259

Contents: Introduction to compilers, compilers and translators, phase structure of a typical compiler, Number of passes, ideas about lexical analysis, syntax analysis, code optimization and code generation, design of lexical analyzer.

Syntax specification of programming languages**,** Design of top-down parser, bottom up parsing technique, LR parsing algorithm, Design of SLR, LALR,LR parsers. Dealing with ambiguity of the grammar.

Study of syntax directed definitions and syntax directed translation schemes as notational frame work to specify the translations. Using syntax directed translation schemes for translation of expressions, controls structures, declarations, procedure calls.

Symbol table management, Error detection and recovery, error recovery in LR parsing, error recovery in LL parsing, Automatic error recovery in YACC

Introduction to Important code optimization techniques, loop optimization, control flow analysis, data flow analysis, setting up data flow equations to compute reaching definitions, available expressions, Live variables.

Problems in code generation, simple code generator code generation from DAG, Peephole optimization.

Text Book:

1. Aho, A.V., and Ullman, J.D., Principles of Compiler Design, Narosa Publishing House, 2002.

Reference Books:

1. Holub, A.I., Compiler Design in C, Prentice-Hall of India, 2006.
2. Fischer, C.N., Cytron, R.K. and LeBlanc, R.J., Crafting a Compiler, Addison Wesley, 2010.

Course Code: **CSL353**
Course Title: **DATA SCIENCE**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Introduction: What is Data Science?, Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Linear algebra for data science (algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Linear algebra for data science (geometric view - vectors, distance, projections, eigenvalue decomposition). Statistical Inference: Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix), Statistics (Understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates), Populations and samples, Statistical modeling, probability distributions, fitting a model, Intro to R.
Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm). Data Visualization: Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects, Exercise: create your own visualization of a complex dataset. Machine Learning Algorithms: Under Machine Learning, topics to be covered are Supervised Learning, Unsupervised Learning, Reinforcement Learning, Testing, Evaluation and Validation of Models to say in brief. Linear Regression, Polynomial Regression, Logistic Regression, Decision Trees, Random Forests, Boosted Trees, Naïve Bayes, Bayes Theorem, Ensemble Learning, Ada Boost, Hierarchical Clustering, Divisive and Agglomerative Clustering, DBSCAN, K Means Clustering, K-Nearest Neighbors, Perceptron's, Gradient Descent, Multi-Layered Perceptron's(MLP), L1 and L2 Regularization, Cross Validation, Entropy, Train-test, F1 Score, Accuracy, Precision, Recall, Support Vector Machines, Collaborative Filtering, Confusion Matrix, Principal Component Analysis, Dimensionality Reduction and Neural Networks. Deep Learning: Under Deep Learning, the topics to be covered are- Neural Networks, Feed Forward Neural Networks, Fuzzy Logic, Hyperparamaters Optimization, Sequence Models, Long Short Term Memory (LSTM), Recurrent Neural Nets(RNN), Convolutional Neural Nets(CNN), YOLO, Object Detection, Natural Language Processing, Computer Vision using OpenCV, etc. Big Data: Topics under Big Data include MapReduce, Hadoop, Apache, Spark, Hive, Pig, Mahout, Yarn, Big Data Analytics, etc. Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs. Data Science and Ethical Issues: Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists.

Text Book:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
2. Christopher M. Bishop F.R.Eng., Pattern Recognition and Machine Learning, Springer.

Reference Books:

1. Gilbert Strang, Introduction To Linear Algebra, Wellesley-Cambridge Press and SIAM, Fifth Edition (2016).
2. Douglas Montgomery, Applied Statistic And Probability For Engineers, John Wiley & Sons, Inc., Third Edition.
3. Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville (http://www.deeplearningbook.org.)
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online).

Course Code: **CSL354**
Course Title: **INFORMATION AND NETWORK SECURITY**
Structure (L-T-P): **3-0-0**
Pre-requisites: **CSL 255, CSL252**
Contents: Classical Ciphers: Affine, Playfair, Hill Cipher, Modern Block and Stream Ciphers: DES, AES, RC4, A5/1, Block Modes of Operation: ECB, CBC, CFB,OFB, CTR Asymmetric Key Cryptosystems: RSA, Digital Signatures: DSS,
Hash and MAC: SHA-512 Key Management: Digital Certificates, PKI, Authentication: One-Way Authentication, Mutual Authentication, Dictionary Attacks, Centralized Authentication, The Needham-Schroeder Protocol, Kerberos, Network Layer Security: IPSec, Transport Layer Security: SSL/TLS Non-cryptographic Protocol Vulnerabilities: DoS and DDoS, Session Highjacking and Spoofing, ARP Spoofing and Attacks on DNS, Software Vulnerabilities: Phishing, Buffer overflow, cross site scripting and SQL injection Viruses, Worms, and other Malware: Virus and Worm Features, Internet Scanning Worms, Mobile Malware and Botnets, Access Control in Operating Systems: Discretionary Access Control, Mandatory Access Control, Role Based Access Control, SELinux and Recent Trends ,RFIDs and E-Passports Electronic payment.

Text Books:

1. Forouzan, B.A. and Mukhopadhyay, Debdeep, Cryptography and Network Security, 2nd ed., Tata McGraw Hill, 2013.
2. Stallings, W., Cryptography and Network Security: Principles and Practice, 6th ed., Pearson, 2014.

Reference Books:

1. Schneier, B., Applied Cryptography: Protocols, Algorithms and Source Code in C, 2nd ed., Wiley-India, 2007.
2. Stinson, D.R., Cryptography: Theory and Practice, 3rd ed.,Chapman and Hal CRC Press, 2006.
3. Menezes, A.J., Oorschot, P.C.V. and Vanstone, S.A., Handbook of Applied Cryptography, 5th ed., CRC Press, 2001.
4. Kaufman, C., Perlman, R. and Speciner, M., Network Security: PrivateCommunication in a Public World, 2nd ed., Prentice Hall, 2010.
5. Pfleeger, C.P. and Pfleeger, S.L., Security in Computing, 4th ed., Prentice Hall, 2012.

Course Code: **CSL355**
Course Title: **ARTIFICIAL INTELLIGENCE**
Structure (L-T-P): **3-0-0**
Pre-requisite: **CSL254**
Contents: Introduction: What is AI? , History, Overview, Intelligent Agents, Performance Measure, Rationality, Structure of Agents, Problem-solving agents, Problem Formulation, Uninformed Search Strategies**,** Informed (Heuristic) Search and Exploration, Greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions, inventing admissible heuristic functions, Local Search algorithms, Hill-climbing, Simulated Annealing, Genetic Algorithms, Online search**,** Constraint Satisfaction Problems, Backtracking Search, variable and value ordering, constraint propagation, intelligent backtracking, local search for CSPs, Adversarial Search, Games, The minimax algorithm, Alpha-Beta pruning, Imperfect Real-Time Decisions, Games that include an Element of Chance Knowledge Based Agents, Logic, Propositional Logic, Inference, Equivalence, Validity and Satisfiability, Resolution, Forward and Backward Chaining, DPLL algorithm, Local search algorithms, First Order Logic, Models for first order logic, Symbols and Interpretations, Terms, Atomic sentences, complex sentences, Quantifiers, Inference in FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution Planning, Language of planning problems, planning with state-space search, forward and backward state-space search, Heuristics for state-space search, partial order planning, planning graphs, planning with propositional logic. Uncertainty, Handing uncertain knowledge, rational decisions, basics of probability, axioms of probability, inference using full joint distributions, independence, Baye's Rule and conditional independence, Bayesian networks, Semantics of Bayesian networks, Exact and Approximate inference in Bayesian Networks.

Text Book:

1. Russell, S.J. and Norvig, P., Artificial Intelligence: A Modern Approach, 3rded.,Pearson Education, 2014.

Reference Books:

1. Nilsson, N.J. Artificial Intelligence and New Systems, 1st ed.,Elsevier, 2011.
2. Patterson, D. W. Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, 2012.

Course Code: **CSL356**
Course Title: **DIGITAL IMAGE PROCESSING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Digital Image Fundamentals: Image Model, Sampling, Quantization, Neighborhood, connectivity of pixels, Labeling of connected components, Distance measures Image

Transforms: Fourier Transform, Discrete Fourier Transform, Properties of 2D Discrete Fourier Transform, The fast Fourier Transform and its algorithm, number of operations, the inverse FFT. Discrete Cosine Transform and its applications, KL Transform, Convolution and correlation Image Enhancement: Enhancement by point processing, spatial filtering, enhancement in frequency domain, generation of spatial masks from frequency domain specifications Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation Representation and Description: Representation schemes, boundary descriptors, regional descriptors. Morphology: Dilation, erosion, opening, closing, Hit-or-Miss Transform, so me basic morphological algorithms like pruning, thinning and thickening

Text Book:

1. Gonzalez and Woods. Digital Image Processing, Addison Wesley, 2nd Edition, 2007.

Reference Book:

1. A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1st Edition, 1988

Course Code: CSL357
Course Title: WEB TECHNOLOGIES
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Planning and designing a website, maintaining view state, connecting and hosting database, choosing a web server for hosting, domain name registration, configuration and optimization settings, promotion and maintenance of website Uniform Resource Locators (URLs) & Web Browser, Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Method, Web technologies: Terminology & Applications; Active X Components, XML, Chat applets, Ajax, Servlet, Java Beans, J2ME, SQL, Ftp Android: Ice cream Sandwich, Jellybean Peer to Peer and Cloud Network, Social Network Analysis, development of the social networks analysis, Electronic Sources for Network Analysis –Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Text Books:

1. J .Davies, R.Studer, P.Warren. Semantic Web Technologies, Trends and Research in Ontology Based Systems, John Wiley & Sons, 2006.
2. Liyang Yu. Introduction to Semantic Web and Semantic Web Services, CRC Press, 2007.
3. Heiner Stuckenschmidt, Frank Van Harmelen. Information Sharing on the semantic Web, Springer Publications, 2005.
4. T. Segaran, C.Evans, J.Taylor. Programming the Semantic Web, O"Reilly, 2009.

Course Code: CSL358
Course Title: INFORMATION RETRIEVAL
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Boolean retrieval, the term vocabulary and postings lists, Dictionaries and tolerant retrieval, Introduction to index-construction and index-compression. Scoring, term weighting and the vector space model, Computing scores in a complete search system, Evaluation in information retrieval, Introduction to Relevance feedback and query expansion.
Probabilistic information retrieval, review of basic probability theory, the probability ranking principle, the binary independence model Language models for information retrieval, Language modeling versus other approaches to IR, Text classification and Naive Bayes, Bayesian Network approaches to IR. Vector space classification, Support vector machines and machine learning on documents, Flat clustering, Hierarchical clustering, Matrix decomposition and latent semantic indexing. Introduction to Web search basics, Web crawling and indexes, Link analysis.

Text Books:

1. Manning, C.D., Raghavan, P. and Schu¨tze, H.,Introduction to Information Retrieval, Cambridge University Press, England, 2012.
2. Bu¨ttcher,S., Clarke, C.L.A. and Gordon V Cormack, Information Retrieval: Implementing and Evaluating Search Engines,MIT Press, 2010.

Reference Books:

1. Grossman, D.A. and Ophir, F.,Information Retrieval: Algorithms and Heuristics, Springer, 2013.
2. Frakes, W.B., Pearson, Information Retrieval: Data Structures and Algorithms,Prentice Hall, 2002.

Course Code: CSL359
Course Title: NEURO-FUZZY TECHNIQUES
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.
Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.
Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Application of Fuzzy Logic: Medicine, Economics etc.
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks
Genetic Algorithm: An Overview of GA, GA operators, GA in problem solving, Implementation of GA.

Text Books:

1. Haykin, S.S., Neural Networks and Learning Machines, 3rd ed., PHI Learning, 2013.
2. Ross, T.J., Fuzzy Logic with Engineering Applications, 3rd ed., John Wiley & Sons, 2013.

Reference Books:

1. Aliev, R.A. and Aliev, R.R., Soft Computing and its Applications, World Scientific, 2001.
2. Kosko, B., Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Prentice-Hall of India, 1994.
3. Yegnanarayana, B., Artificial Neural Networks, Prentice Hall of India, 2006.
4. Jang, J-S.R., Sun, C-T. and Mizutani, E., Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI Learning, 2010.
5. Hertz, J.A., Krogh, A. and Palmer, R.G., Introduction to the Theory of Neural Computation, Addison Wesley, 1999.
   Mehrotra, K., Mohan, C. K. and Ranka, S., Elements of Artificial Neural Networks, Penram International Publishing,1997.

Course Code: CSL360
Course Title: COMPUTER GRAPHICS
Structure (L-T-P): 3-0-0
Pre-requisite: CSL251
Contents: Basic fundamentals of random scan, raster-scan devices, LCD displays - point and line drawing techniques and algorithms - input/output devices and interactive techniques.
Polygon filling methods: Seed fill, edge flag algorithm etc. - scan conversion techniques - anti aliasing techniques - clipping algorithms, Polygon clipping, Viewing transformation, Windowing transformation.
Linear transformation: rotation, scaling, translation in 3D - homogeneous coordinates - normalized device coordinates - windowing and view porting, Cartesian Coordinates, Word view etc.
Curve generation - cubic splines, Beziers, blending of curves- other interpolation techniques, Displaying Curves and Surfaces, Shape description requirement, parametric function. Review of 3D vector algebra - parallel and perspective projections and transformation -

hidden line/ surface elimination - shading and rendering - ray tracing techniques.
Graphics software packages - segmentation and display files - graphics standards graphics and computer networks - basic principles of X windows, X terminals, Functions for segmenting display files.

Text Book:

1. Rogers, D.F., Procedural Elements for Computer Graphics, 2nd ed., Tata McGraw Hill, 2012.

Reference Books:

1. Hearn, D. and Baker, M.P., Computer Graphics, Prentice Hall of India, 2003.
2. Foley, J.D., Introduction to Computer Graphics, Addison-Wesley, 2010.

Course Code: CSL451
Course Title: REAL-TIME SYSTEMS
Structure (L-T-P): 3-0-0
Pre-requisite: CSL252
Contents: Real time applications: Hard and soft real time systems, timing constraints, A Reference model of Real-time systems, temporal parameters, precedence constraints & dependencies, scheduling Hierarchy, Commonly used approaches to scheduling, cyclic and priority drive approaches, Optimality of EDF and LST. Clock Driven Scheduling: Static timer driven scheduler, Cyclic Executives, Improving Average Response times of Aperiodic Jobs, Scheduling Sporadic jobs, Practical Considerations, Pros and Cons of Clock Driven Scheduling Priority-driven scheduling of periodic tasks: Fixed Priority vs Dynamic Priority schemes, Maximum schedulable Utilization, Optimality of the RM and DM algorithms, As Schedulable Test for Fixed Priority Tasks, Practical Factors.
Scheduling Aperiodic and Sporadic Jobs in Priority-driven scheduling: Deferrable Servers, Sporadic Servers, Constant Utilization. Total Bandwidth, and Weighted Fair-Queuing Servers, Scheduling of Sporadic Jobs.
Resources and resource access control: non preemptive critical sections, basic priority-inheritance, ceiling protocol, multiprocessor scheduling, predictability and validation of dynamic multiprocessor systems flexible applications, tasks with temporal distance constraints.
Real time Operating systems: Overview, Time Services and Scheduling Mechanisms, Basic Operating System Functions, Processor Reserves and Resource Kernel, Open System Architecture, Capabilities of Commercial RTOS.

Text Book:

1. Liu, J.W.S., Real-Time Systems, Pearson Education, 2013.

Reference Book:

1. Krishna, C.M. and Shin, K.G., Real Time Systems, 3rd ed.,Tata McGraw Hill, 2010

Course Code: CSL452
Course Title: CLOUD COMPUTING
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Virtualization: Introduction, technologies and architectures, Internals of virtual machine monitors/ hypervisors, Process Virtual Machines: containerization, System Virtual Machines, Dynamic Binary Optimization, Multiprocessor Virtualization, Live migration mechanisms. Overview of Cloud computing, Cloud Services: infrastructure-as-a service (IAAS), platform-as-a-service (PAAS) and software-as-a-service (SAAS), Cloud deployment Models – public, private, community and hybrid Cloud, HPC in Cloud computing, Cloud-in-a-box. Cloud enabling technologies: Hadoop, Map-reduce, etc.
Case Study: Implementation examples of Cloud services: Projects in Cloud (using AWS, MS Azure, Open stack Oracle etc.) Case studies from Industry perspective: Implement/ outline architecture for large Enterprise (>100 applications), Implement monitoring in form of CC (Command center), Generate analytics reports (predictive etc.) AI/ML.

Text Books:

1. Resse, George. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. O' Reilly, 2009.
2. Smith, James E., and Ravi Nair. Virtual Machines: Versatile Platforms for Systems and Processes. Morgan Kaufmann, 2005.

Reference Book:

1. Buyya, Rajkumar, James Broberg, and Andrzej Goscinski. Cloud Computing – Principles and Paradigms, Wiley, 2011.

Course Code: CSL453
Course Title: INTERNET OF THINGS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: IoT-An Architectural Overview– building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management. Reference Architecture: IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Data Link Layer & Network Layer Protocols: PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP. Upper Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS), Session Layer: HTTP, CoAP, XMPP, AMQP, MQTT, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer

Text Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the
2. Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
3. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014.
4. Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011.
5. Kazem Sohraby, Daniel manoli, "Wireless Sensor networks-Technology, Protocols and Applications", Wiley InterScience Publications 2010.
6. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005.
7. C.S Raghavendra, Krishna M.Sivalingam, Taiebznati , "Wireless Sensor Networks", Springer Science 2004.

Course Code: CSL454
Course Title: MACHINE LEARNING
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Introduction: Basic concepts; Supervised learning: Artificial Neural Network, Classifying with k-Nearest Neighbor classifier, Support vector machine classifier, Decision Tree classifier, Naive Bayes classifier, Bagging, Boosting, Improving classification with the AdaBoost meta algorithm. Forecasting and Learning theory: Predicting numeric values: regression, Linear Regression, Logistic regression, Tree-based regression. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, Vapnik–Chervonenkis (VC) dimension, Worst case (online) learning.

Unsupervised learning:, Grouping unlabeled items using k-means clustering, Association analysis with the Apriori algorithm, efficiently finding frequent item sets with FP-growth. PCA (Principal components analysis), ICA (Independent components analysis); Introduction to deep neural networks - Deep Feed forward Networks, CNN, Auto Encoders; Reinforcement learning and control: Markov decision process (MDP), Bellman equations, Value iteration and policy iteration, Linear quadratic regulation, Linear Quadratic Gaussian, Q-learning, Value function approximation, Policy search, Reinforce, POMDPs.

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, PHI, 2010 2. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
2. Tom.M.Mitchell, Machine Learning, McGraw Hill International Edition.

Reference Book:

1. Ethern Alpaydin, Introduction to Machine Learning. Eastern Economy Edition, Prentice Hall of India, 2005.

Course Code: **CSL455**
Course Title: **PARALLEL AND DISTRIBUTED COMPUTING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Asynchronous/synchronous computation/ communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

Text Books:

1. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet (DCC) by Kai Hwang, Jack Dongarra & Geoffrey C. Fox (Required).
2. Andrew S. Tanenbaum and Maarten van Steen. "Distributed Systems: Principles and Paradigms" (DSPD), Prentice Hall, 2nd Edition, 2007.

Course Code: **CSL456**
Course Title: **MULTIMEDIA TECHNOLOGIES**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Multimedia Definition, Properties of a Multimedia System, Multimedia Building Blocks, Modes of data transmission, Asynchronous Transmission Mode, Synchronous Transmission Mode, Isochronous, Transmission Mode. Multimedia Information Representation: Analog Signal, Waves, General properties of Analog Signals, Digital Representation, Need for digital representation, Analog to digital conversion, Nyquist's Sampling Theorem, Encoder Design, Digital to Analog conversion, Decoder design and its principles, Encoder – Decoder, Relation between sampling rate and bit depth. Discrete Media: Types of Media, Time Independent Media, Time dependent Media, Text, Unformatted Text, Formatted Text, Hyper Text, Essential Features of HTML, Graphics and Images, Creation of Computer Graphics, Digitized documents, Digitized Pictures, Digitized Cameras, Raster Scan Principles, Image Analysis, Image Transmission. Continuous Media: Audio, Speech Signals, Analog Signals, PCM Speech, CD- Quality audio, Synthesized audio, Types of Synthesizers, Characteristics of Synthesizers, Streaming Video, File Formats, Streaming Methods, Sound Fundamentals, Music, MIDI Basic concepts, MIDI Devices, MIDI Messages, Video, Broadcast Television, Digital Video – Format, 0 Format, HDTV Format, SIF, CIF, QCIF, PC Video and Video Content. Text Representation and Compression: Compression Principles, Source Encoders and destination decoders, Lossless and Lossy Compression, Entropy Encoding, Source Encoding, Text Compression, Static Huffman coding, Arithmetic Coding. Image Storage and Compression: Introduction to images, Digital image representation, Vector Graphics and Bitmapped images, History and advantages, Bitmap concept, Stored Images, Bitmap versus Vector Graphics, Captured Image Format, Stored Image Format, Graphics Interchange Format (GIF), GIF Coding Standard, Tagged Image File Format (TIFF), Joint Photographic Experts Group (JPEG), Image/Block Preparation, Forward DCT, Quantization, Entropy Encoding, Frame building, JPEG decoding. Audio Representation and Compression: Introduction to Audio Compression, Differential pulse code modulation, Adaptive differential PCM, Adaptive Predictive Coding, Linear Predictive Coding, Code- excited LPG, Perceptual Coding, Sensitivity of the ear, Frequency marking, Temporal marking, G series Voice coding standards, MPEG audio Coders. Video Representation and Compression: Video Compression Principles, Frame types, Motion estimation and Compression, Implementation Issues, Performance, Characteristics of Digital Video, Streaming Video, Combining sound and Pictures, H.261 Video Compression Standard, H.263, Digitization Formats, Motion Pictures Experts Group (MPEG), MPEG-1, MPEG-2, MPEG-4, Audio and Video Compression. Multimedia I/O Devices, Multimedia Storage Devices, Multimedia Connecting Devices: Multimedia Hardware, Connecting Devices, SCSI, MCI, IDE, USB. Multimedia Application Design: Multimedia Application classes, Types of Multimedia System, Virtual Reality Design, Components of Multimedia System, Organizing Multimedia Databases, Application Overflow design Issue. Multimedia Interactive Applications: Video Conferencing, Video On demand, Educational applications and authoring, Industrial applications, Multimedia archives and digital libraries. Distributed Multimedia Systems.

Text Books:

1. Ralf Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communications & Applications , Pearson Ed.
2. Nalin K. Sharda, Multimedia Information System , PHI.

Reference Books:

1. Fred Halsall, Multimedia Communications, Pearson Ed.
2. Koegel Buford, Multimedia Systems, Pearson Ed.
3. Fred Hoffstetter, Multimedia Literacy, McGraw Hill.
4. Ralf Steinmetz and Klara Nahrstedt, Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing, PHI.
5. J. Jeffcoate, Multimedia in Practice: Technology and Application, PHI.
6. Prabhat K. Andleigh & Kiran Thakrar, Multimedia Systems Design, PHI.

Course Code: **CSL457**
Course Title: **CONCEPTS IN BLOCKCHAINING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash functions, Digital Signature-ECDSA, Memory Hard Algorithm, Zero Knowledge Proof. Blockchain: Introduction, History, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain. Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin. Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects – Cryptocurrency Exchange, Black Market and Global Economy
Blockchain Applications: Internet of Things, Medical Record Management System, Smart contracts, future of Blockchain etc. The use cases from different application domains.

Text Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder. Bitcoin and Cryptocurrency

Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
2. Roger Wattenhofer, The Science of the Blockchain, 2016.
3. Don Tapscott, Alex Tapscott. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World, 2018.
4. Melanie Swan. Blockchain: Blueprint for a New Economy, 2015.

Course Code: **CSL458**
Course Title: **CYBER FORENSIC**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Introduction to computer and cyber forensics basics like Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues. Types of cybercrime and cyber laws, Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations. Data and Evidence Recovery, Deleted file recovery, recovery Tools, Forensics Tools.

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

Introduction to IT laws and Cyber Crimes, Security Attacks, Digital Evidence collection, preservation and investigation. Current computer forensics tools- software, hardware tools, Incidence response, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case. Methodologies of forensics: Case Studies.

Text Books:
1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

Reference Book:
1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Course Code: **CSL459**
Course Title: **SYSTEM PROGRAMMING**
Structure (L-T-P): **3-0-0**
Pre-requisites: **CSL251, CSL258**
Contents: Assembler, Macro processor - Concept of assembler, design of single pass and two pass assembler, forward reference, design of output file of assembler, concept of macro, macro call within macro, macro definition within macro, recursive macro calls, design of macro processor.

Linker and Loader - Concept of static and dynamic relocation, external symbols, design of linker, design of object file for different loading schemes.

Common Object file format - Structure of object file and executable file, section or segment headers, symbol table, concept of storage class.

System utilities –Shell programming, make, link editor, symbolic debugger, pattern matching language like awk.

Device Drivers - Incorporation of driver routines, Basic device driver operation, character and block drivers.

Text Books:
1. Beck, L.L. and Manjula, D., System Software: An Introduction to Systems Programming, 3rd ed., Pearson Education, 2013.
2. Gorsline, G.W, Assembly and Assemblers: The Motorola MC68000 Family, Prentice Hall, 1988.

Reference Books:
1. Dhamdhere, D.M., Systems Programming, Tata McGraw Hill Education, 2011.
2. Kernighan, B.W. and Pike, R.,The Unix programming Environment, Prentice Hall of India, 1993.
3. Egan, J.I. and Teixeira, T.J., Writing a UNIXDevice Driver, 2nd ed., John Wiley and Sons, 1992.
4. Norton, D.A., Writing Windows Device Drivers, Addison Wesley, 1996.
5. Pajari, G., Writing UNIX Device Drivers, Pearson Education, 1995.
6. UNIX System Utilities Manual.

Course Code: **CSL460**
Course Title: **FUNDAMENTAL ALGORITHMS IN COMPUTATIONAL BIOLOGY**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: DNA and Sequence Alignment – KMP-algorithm, BLAST and FASTA, Sorting by Reversals, Biological Databases – formats, downloading and using data, Phylogeny – Distance based algorithms (Hamming /Euclidian distance), Suffix Trees, Prediction of RNA secondary structure, Gene Prediction using Bayesian Methods and Markov Chains/HMMs, Modeling-Based on Cellular Automata, Based on Agent Based Modeling Techniques, Based on Partial Differential Equations, Single Nucleotide Polymorphism and algorithms for their identification, Microarray Data and Clustering – Hierarchical/K-Means, Pathway Data and their analysis, Protein Folding and Docking based on Entropy Calculation.

Text Books:
1. Ellner, S. P. and Guckenheimer, J., Dynamic Models in Biology, New Age International, 2010.
2. Murray, J. D., Mathematical Biology: An Introduction, 3rd ed., Springer, 2002.

Reference Book:
1. Mandoiu, I.and Zelikovsky, A., Bioinformatics Algorithms: Techniques and Applications. Wiley Series on Bioinformatics: Computational Techniques and Engineering, John Wiley & Sons, 2008.

B. Tech. (Electrical and Electronics Engineering)

OVERALL CREDIT STRUCTURE

Undergraduate Core (UC)		Undergraduate Elective (UE)	
Category	*Credit*	*Category*	*Credit*
DC	67	**DE**	23 (minimum)
BS	19	**HM**	06 (minimum)
ES	22	**OC**	18 (Balance)
HM	05	**UN**	0 (03 Courses)
Total	113	**Total**	47
Grand Total (UC + UE)			**160**

Basic Science (BS)

Course Code	Course	L-T-P	Credit
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL251	Applied Mathematics-III*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)

Course Code	Course	L-T-P	Credit
HMP152	Technical Communication	2-0-2	03
HML151	Social Science	2-0-0	02
Total			**05**

Engineering Arts and Science (ES)

Course Code	Course	L-T-P	Credit
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
MEL151	Basic Electronics Engineering	3-0-0	03
MEP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	0-0-2	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	01
CEL151	Environmental Science	2-0-0	02
Total			**22**

Non Credit Requirement (UN)

Course Code	Course	L-T-P	Credit
NCN151	NCC#	-	0
NCN152	NSS#	-	0
NCN153	NSO#	-	0
SPB151	Sports-I#	0-0-4	0
SPB152	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
EET251	Practical Training	-	0

#A student has to opt at least one from NCC, NSS, NSO and Sports (I & II both).

Departmental Core (DC)

Course Code	Course	L-T-P	Credit
EEL251	Basic Electrical Circuits	3-0-0	03
EEP251	Basic Electrical Circuits Lab	0-0-2	01
EEL252	Measurement & Instrumentation	3-0-0	03
EEP252	Measurement & Instrumentation Lab	0-0-2	01
EEL253	Electrical Machines I	3-0-0	03
EEP253	Electrical Machines I Lab	0-0-2	01
EEL254	Control System	3-0-0	03
EEP254	Control System Lab	0-0-2	01
EEL255	Power Electronics	3-0-0	03
EEL256	Power System I	3-0-0	03
ECL251	Signals and Systems	3-2-0	04
ECL252	Analog Circuits	3-0-0	03
ECP252	Analog Circuit Lab	0-0-2	01
ECL254	Engineering Electromagnetics	3-0-0	03
ECL256	Digital Circuits	3-0-0	03
ECP256	Digital Circuits Lab	0-0-2	01
EEL351	Electrical Machines II	3-0-0	03
EEP351	Electrical Machines II Lab	0-0-2	01
EEL352	Electric Drives	3-0-0	03
EEP352	Electric Drives Lab	0-0-2	01
EEL353	Power System II	3-0-0	03
EEL354	Advanced Power Electronics	3-0-0	03
EEP354	Power Electronics Lab	0-0-2	01
EEL355	Switchgear & Protection	3-0-0	03
EEP355	Switchgear & Protection Lab	0-0-2	01
ECL351	Linear Integrated Circuits	3-0-0	03
ECP351	Linear Integrated Circuits Lab	0-0-2	01
ECL353	Microcontroller & Interfacing	3-0-0	03
ECP353	Microcontroller & Interfacing Lab	0-0-2	01
EED 351	Minor Project	-	01
EED 451	Major Project	-	02

Departmental Elective (DE)

Course Code	Course	L-T-P	Credit
EEL 451	Computer Control and Automation of Power Systems	3-0-0	03
EEL 452	Discrete Data and Digital Control	3-2-0	04
EEL 453	Power Plant Engineering	3-0-0	03
EEL 454	HVDC	3-0-0	03
EEL 455	Power System Economics and Management	3-0-0	03
EEL 456	System Engineering	3-2-0	04
EEL 457	Pulse Width Modulation for Power Converters	3-0-0	03
EEL 458	Soft Computing Techniques	3-0-0	03
EEL 459	Commissioning and Testing of Electrical Systems	3-0-0	03
EEL 460	Control System Design	3-2-0	04
EEL 461	Electrical Energy System	3-0-0	03
EEL 462	Electrical Distribution System	3-0-0	03
EEL 463	High Voltage Engineering	3-0-0	03
EEL 464	Power Quality Issues & Solutions	3-0-0	03
EEL 465	Electrical Engineering Material	3-0-0	03
EEL 466	Power System Operation and Control	3-0-0	03
EEP 467	Soft Computing Techniques Lab	0-0-2	01
ECL352	Digital Signal Processing	3-0-0	03
ECP352	Digital Signal Processing Lab	0-0-2	01
ECL469	Hardware Description Language	3-0-0	03
ECP469	Hardware Description Language Lab	0-0-2	01
SCL452	Linear Algebra	3-0-0	03
SCL453	Probability Theory & Statistics	3-0-0	03
MEL461	Robotics	3-0-0	03
MEP461	Robotics Lab	0-0-2	01
CSL253	Object Oriented Design	3-0-0	03
CSL251	Data Structures	3-0-0	03
CSP251	Data Structures Lab	0-0-2	01
CSL359	Neuro-Fuzzy Techniques	3-0-0	03

Course Syllabi (Under Graduate)
Department of Electrical Engineering

Course Code: **EEL151**
Course Title: **ELEMENTARY ELECTRICAL ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Electrical circuit, circuit elements resistance, inductance & capacitance, Kirchhoff's laws, voltage source & current source, superposition theorem, Thevenin's theorem, norton's theorem, duality, star-delta transformation. *DC Transients*
AC circuits, periodic function, average & r.m.s. values, steady state behavior with sinusoidal excitation, phase representation, reactance & impedance, power and power factor, series & parallel circuit, resonance and quality factor, principle of generation of single phase & three phase voltages, power in balanced three phase ac system.
Power systems: elementary idea about bulk power generation, long distance transmission and distribution, industrial and residential distribution, safety & legal standards.
Magnetic circuit, flux, mmf, reluctance, analogy with electric circuits. Simple calculations for composite magnetic circuits. *Magnetic Coupling Coefficient*
Measurement of electrical current, voltage and energy in ac & dc systems.
Transformer: introduction, basic principles, construction, phasor diagram for transformer under no load condition, transformer on load, balance of mmf on both sides, phasor diagram, equivalent circuit, open circuit & short circuit test.
Electric Machines:
1. DC shunt and series motor – construction, principle of working and applications, need of starters, torque and speed control.
2. Induction motors – construction, principle of working of single phase and 3-phase motors, torque-slip characteristics.

Text Books:

1. Hughes, E., Electrical and Electronics Technology, 10th ed., Pearson Education, 2013.
2. Toro,V.D., Electrical Engineering Fundamentals, 2nd ed., Prentice Hall of India, 2012.

Reference Books:

1. Kothari D.P., Nagrath I.J, Theory and Problems of Basic Electrical Engineering, Prentice Hall India 2011.
2. Kulshreshtha, D.C., Basic Electrical Engineering, Tata McGraw Hill, 2013.

Course Code: **EEL251**
Course Title: **BASIC ELECTRICAL CIRCUITS**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151**
Contents: Classification of elements of an electrical circuit, Resistors, Inductors, Capacitors, Controlled sources, Diodes and ideal transformers. Basic circuit analysis methods nodal, Mesh and modified nodal-analysis. Transient analysis of RL, RC and RLC circuits.
Network theorems: Tellegen's theorem, Superposition theorem, Thevenin theorem, Norton theorem, Substitution theorem, Reciprocity theorem, Maximum power transfer theorem, Network analysis methods, Poly-phase circuits. Circuits transformers, Laplace transforms and their adaptation to networks. Two port networks, Two-port parameters, Interconnection of two ports and their effect on the parameters.
Tellegen's generalized reciprocity theorem, Multiport and multiterminal networks, their representations and interconnections.
Graphs: paths, connectedness, circuits, cutsets, trees, matrix representation of directed graphs, incidence, cutset and circuit matrices, methods of analysis of linear networks, nodal, cutset, mesh and loop analysis.
Trigonometric and exponential Fourier series, discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalance circuit and power calculation. Frequency domain approaches to electrical networks.
Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and integral solutions. Pole-zero concept, network synthesis: Hurwitz polynomial, Properties of Hurwitz polynomial, Positive real functions and their properties, Concepts of network synthesis, Realization of simple R-L, R-C and L-C functions in Cauer-I, Cauer-II, Foster-I and Foster-II forms.
Elements of Filter Theory: introduction, classification of filters, introduction of windows, butter worth filter challenge filter equation of ideal filter, image parameters and characteristics impedance, passive and active filter of various filter, low pass, high pass, constant K type, M derived filters and their design.
Transmission line parameters and performance, operation for maximum power transfer, characteristic impedance.

Text Books:

1. Hayt, W.H. and Kemmerley, J.E. and Durbin, S.N., Engineering Circuit Analysis, 7th ed., McGraw Hill, 2013.
2. Valkenburg, M. E. Van, Network Analysis, 3rd ed. Prentice Hall India, 2011.
3. Hayt, W.H. and Kemmerley, J.E. and Durbin, S.N., Engineering Circuit Analysis, 7th ed., McGraw Hill, 2013.
4. M. E. Van Valkenburg: Network Analysis, 3rd ed., Prentice Hall of India.
5. Choudhury, D.R., Networks and Systems, 2nd ed., New Age Publication, 2014.

Reference Books:

1. Murthy, K.V.V.and Kamath M.S, Basic Circuit Analysis, 8th ed., Jaico Publishing House, 2010.
2. Choudhury, D.R., Networks and Systems, 2nd ed., New Age Publication, 2014.
3. Chua , L.O., Desoer, C.A. and Kuh, E.S., Linear and Nonlinear Circuits, McGraw Hill, 1991
4. Murthy, K.V.V. and Kamath M.S, Basic Circuit Analysis, 8th ed., Jaico Publishing House, 2010.

Course Code: **EEL252**
Course Title: **MEASUREMENT & INSTRUMENTATION**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL 251**
Contents: Classification of measuring instruments, comparison of analog and digital instruments, advantages of digital instruments, classification of analog instruments, absolute and secondary instruments, indicating type, recording type and integrating type instruments, loading effect of instruments.
Measurement of resistance: classification, measurement of low resistance by Kelvins' double bridge, measurement of medium resistance by voltmeter-ammeter method, Wheatstone bridge. Measurement of high resistance by Ohmmeter, Megger and loss of charge method, general theory of AC bridges, study of Maxwell, Hay's, Owen's, De Sauty's, Wien and Schering bridges, detectors for AC bridges.
Principles and use of D.C. potentiometer for calibration purposes, principle and applications of A.C. potentiometer. ammeter, voltmeter, principles of moving coil, moving iron and dynamometer type instruments, extension of range using series and shunts, error due to extension of range, digital voltmeter : types of DVM, integrating type DVM. Oscilloscope, working principle and its operations. Measurement of active and reactive power in polyphase circuits using dynamometer type instruments, measurement of energy in single and polyphase circuits using induction type instruments. Errors in power and energy measurements, class of accuracy, maximum demand indicator, trivector meter.
General theory of extension of range using CT and PT, errors in instrument transformers, applications of instrument transformers. Special instruments: power factor meter, frequency meter, synchroscope, rectifier type instrument, measurement of non-electrical quantities, digital frequency meter.

Text Books:

1. Sawhney, A.K., A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, 2013

2. E.W. Golding & F.C. Widdis, "Electrical Measurement and Measuring Instruments", A.W. Wheeler and Co.Pvt. Ltd. India.

Reference Book:

1. E.O. Doebelin and D. N. Manik, "Measurement systems application and design", TMH, New Delhi.
2. Cooper, W.D. and Helfrick, A.D.,Modern Electronic Instrumentation and Measurement Techniques, 3rd ed., PHI Learning Private Limited, 2012.

Course Code: **EEL253**
Course Title: **ELECTRICAL MACHINES-I**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151**

Contents: Transformer: **Single phase transformer** : Phasor diagram for transformer for different loading conditions, equivalent circuit, open circuit & short circuit test , Back to back Test. Voltage regulation, efficiency calculation, parallel operation of transformer, Auto transformer, conversion of two winding transformer to auto transformer.

Three Phase Transformer: Connection and phasor groups, effect of phase sequence, inrush current & harmonics, tertiary winding, open delta connection, Scott connection, Applications.

Basic of Rotating Machines: Rotating magnetic field, Induced EMF, Torque developed

DC Machines: Concept of induced emf, Armature winding and field winding, mmf of armature and field winding. Armature reaction, its bad effects and steps to limit the effects of armature reaction, Staring of Motor

DC Motor: Basic principle and operation, classification, torque, power, losses and efficiency, characteristics. Speed control of DC motor, Braking.

DC Generator: Emf equation, shunt and compound generator, losses and efficiency , characteristics & Applications.

Text Books:

1. Fitzgerald, A.E., Kingsley, C. and Umans, S.D., Electric Machinery,6th ed., Tata McGraw Hill, 2014
2. Bhimbhra, P.S., Electrical Machinery, Khanna Publishers, Delhi, 2003.
3. Nagrath, I. J. and Kothari, D. P., Electric Machines, Tata McGraw Hill, 2006.

Reference Books:

1. Bhattacharya, S.K., Electrical Machines, 3rd ed., McGraw Hill Education (India) Private Limited, 2013.

Course Code: **EEL256**
Course Title: **POWER SYSTEM-I**
Structure (L-T-P): **3-2-0**
Prerequisite: **EEL151, EEL251**

Contents: **Power system introduction**: Introduction, comparison of AC and DC systems, overhead versus underground systems, choice of working voltages for transmission and distribution, cost comparison of overhead and underground systems, Classification of Voltage levels, Introduction to HVDC & basic configuration.

Power factor improvement: Necessity of power factor improvement, techniques for power factor improvement, Synchronous condenser, economics

Line parameters: Inductance and Capacitance, skin effect, proximity effect, Graphical method for performance of overhead transmission line.

Transmission line modeling: Characterization of transmission line on basis of length, modeling of long, short and medium transmission line, ABCD parameters. Derivation for voltage drop and power loss in lines efficiency of short, medium and long transmission lines, Surge impedance, SIL.

Mechanical design: Sag and tention calculation in hilly and plain area, Sag and tension calculation with wind and ice effect. Line support, types of conductors; Overhead line insulators, types of insulator spin, suspension and strain insulators, insulator materials, insulator string;

Voltage regulation: Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings, sag calculation, factors affecting sag. power-loss calculations, Manual methods of solution for radial networks,

Corona: Corona formation, factors affecting corona, calculation of potential gradient, disruptive critical voltage and visual critical voltage, corona power loss, minimizing corona, merits and demerits of corona, skin effect.

Travelling Waves: Introduction and mechanism of traveling waves, wave equation, characteristic impedance of a line, incident and reflected waves, transmission and refraction of waves, velocity of traveling waves, behavior of traveling waves for different terminations: inductor, capacitor, open-end, short-end and over the junction of dissimilar lines, attenuation of traveling waves, lattice diagrams.

Surge Performance and Protection: Switching surges, origin and mechanism of lightening strokes, direct and induced strokes, protection from surges- lightning arrestors (rod gap, horn gap, multigap and expulsion type) and surge diverters, evaluation of surge impedance, energy and power of a surge.

Introduction to cables: Introduction, sheath, amour and covering, Classification of cables, Grading of cables, Underground HVDC cables.

Text Books:

1. Nagrath, I. J. andKothari, D.P., Power System Engineering, 2nd ed., Tata McGraw Hill Publications, 2013.
2. C.L Wadhwa, Electrical Power Systems, 6th ed., New Age international publications.

Reference Books:

1. Elgerd, O.I., Electric Energy Systems Theory: An Introduction, 2nd ed., Tata Mc-Graw Hill Education, 2012.
2. Saadat, H., Power System Analysis, 3rd ed., PSA Publishing, 2010.
3. Grainger, J.J., Stevenson, W.D., Power System Analysis, 22th ed., McGraw Hill Education (India) Private Limited, New Delhi, 2014.

Course Code: **EEL254**
Course Title: **CONTROL SYSTEM**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL251**

Contents: Introduction to need for automation and automatic control. Use of feedback, broad spectrum of system application.

Mathematical modeling, differential equations, transfer functions, block diagram, signal flow graphs, application to elementary system simplifications, effect of feedback on parameter variation, disturbance signal servomechanisms and regulators.

Control system components, electrical, electromechanical, and other components. Their functional analysis and input output representation. Controllability and Observability.

Time response of first order and second order system, standard inputs, concept of gain and time constants. Steady state error, type of control system, approximate methods for higher order system.

Root location and its effect on time response, elementary idea of root locus, effect of adding pole and zero and proximity of imaginary axis.

Stability of control systems, conditions of stability characteristic equation, Routh-Hurwitz criterion, special cases for determining relative stability.

Frequency response method of analyzing linear system, Nyquist and Bode plots, stability and accuracy analysis from frequency responses, open loop and close loop frequency response. Nyquist criterion, effect of variation of gain and addition of pole and zero on response plot, stability margins in frequency response.

State variable method of analysis, characteristic of system, state, choice of state representation of vector matrix differential equation standard form, relation between transfer function and state variable.

Text Books:

1. Ogata, K., Modern Control Engineering, 5th ed., Prentice Hall of India, 2012.
2. Nagrath, I.J. and Gopal, M., Control System Engineering, 5th ed., New Age International, 2012.
3. Kuo, B.C. and Golnaraghi F., Automatic Control Systems, 8th ed., Wiley India, 2011.
4. Abbas Emami-Naeini J. Da Powell Gene F. Franklin, Feedback Control of Dynamic Systems, Global Edition 7th Edition.

Reference Books:

1. Dorf R. C. and Bishop R. H., Modern Control Systems, 12th ed., Pearson Education, 2013.

2. D'Azzo J. J., Houpis, C.H. and Sheldon, S.N., Linear Control System Analysis and Design with MATLAB, 6th ed., CRC Press, 2014.
3. Nise, N.S., Control Systems Engineering, 6th ed., Wiley, 2013.
4. Gopal, M., Control Systems: Principles and Design, 3rd ed., Tata McGraw Hill Education, 2010.

Course Code: **EEL255**
Course Title: **POWER ELECTRONICS**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL251**
Contents: Power semiconductors devices and switching circuits: SCR and its characteristics, SCR ratings ,series and parallel operations of SCRs, Triggering circuits, commutating circuits, protection of SCR. Gate circuit protection, over voltage and over current protection, snubber circuit design, converter circuit faults and their protection, Uni-Junction Transistor (UJT), Self Commutating Device: characteristics and working of MOSFET. Gate turn off thyristor and insulated gate bipolar transistor.
AC to DC Converters: working of single pulse and two pulse converters. Three pulse midpoint converter and 3 phase six pulse bridge converter. Effect of source inductance in converters. Effect of freewheeling diode. Speed control of DC motor using converter.
DC to DC Converters: Classification, principles of step down chopper and step up chopper, Buck, Boost, Buck-Boost converter and application to low power circuits.
DC to AC Converters: Single phase and three phase bridge inverters, output voltage control, harmonics in output voltage waveform, harmonics attenuation by filters. Harmonic reduction by pulse width modulation techniques, analysis for single pulse width modulation, working of current source inverters, applications of inverters.
AC to AC Converters: Operation & analysis of single phase integral cycle and phase controlled converters, configuration of three phase controllers, Cycloconverters: Single phase and three phase configurations and operating principle, AC voltage controller Introduction of matrix converter.
Text Books:
1. Mohan, Ned, Undeland, T.M. and Robbins, W.P., Power Electronics, 3rd ed., Wiley India, 2014
2. Rashid, M.H., Power Electronics: Circuits Devices & Applications, 3rd ed., Pearson Education, 2012.
3. Joseph Vithayathil, Power Electronics: Principles and Applications, Tata McGraw-Hill Education.
Reference Books:
1. Singh, M.D. and Khanchandani K.B., Power Electronics, 2nd ed., Tata McGraw Hill Education, 2012.
2. Bose, B.K., Modern Power Electronics and AC Drives, PHI Learning, New Delhi, 2012.
3. Lander, C.W., Power Electronics, 3rd ed., McGraw Hill, 1993.
4. Bimbhra, P.S., Power Electronics, Khanna Publishers, 2012.
5. Dubey, G.K., Fundamentals of Electrical Drives, 2nd ed., Narosa Publication, 2013.

Course Code: **EEL352**
Course Title: **ELECTRIC DRIVES**
Structure (L-T-P): **3-0-2**
Prerequisite: **EEL253, EEL255**
Contents: Definitions, classification and speed torque characteristics of common industrial loads & drive motors and their characteristics under starting, running, braking and speed control.
Introduction:
Review of power converters used in drives, multi-quadrant operation of electric drive, example of hoist operation in four quadrant.
DC Drives:
Single-phase half controlled and fully controlled converter fed dc motor drives, operation of dc drives with continuous armature current, voltage and current waveforms; Concept of energy utilization and effect of free-wheeling diode;
Operation of drive under discontinuous current, expression for speed-torque characteristic.
Chopper fed DC Drives:
Principle of operation and control techniques, chopper circuit configurations used in dc drives: Type A, B, C, D and E; Motoring operation of chopper fed separately excited dc motor, steady state analysis of drive with time-ratio control.
Closed Loop Control of DC Drives:
Drives with current limit control, single-quadrant closed loop drive with inner current control loop, advantage of inner current control loop in drives.
AC Drives:
Variable voltage, rotor resistance and slip power recovery control of induction motors, torque-speed characteristics under different control schemes; Variable frequency control of induction motor, analysis of induction machine under constant V/f operation, constant flux operation and controlled current operation.
Estimation of Drive Motor Rating:
Selection of motor power capacity for continuous duty at constant load and variable loads; Selection of motor capacity for short time and intermittent periodic
duty, permissible frequency of starting of squirrel cage motor for different duty cycles.
Text Books:
1. Dubey, G.K., Fundamentals of Electrical Drives, 2nd ed., Narosa Publication, 2013.
2. Partab H., Modern Electrical Traction; Dhanpat Rai and Co. Pvt. Ltd, 2014.
3. J. M. D. Murphy & F. G. Turnbull, "Power Electric Control of AC Motors", Pergamon Press.
Reference Books:
1. Subrahmanyam, V., Electric Drives: Concepts and Applications, 2nd ed., Tata McGraw Hill Education, New Delhi, 2011.
2. Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., A Course in Electrical Power, Dhanpat Rai & Sons, New Delhi, 1987
3. Bimal K. Bose, "Power Electronics and Variable Frequency Drives: Technology and Applications".

Course Code: **EEL353**
Course Title: **POWER SYSTEM-II**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL251, EEL256**
Contents: General concept: Introduction of bus matrix, Ybus formulation, Tap changing transformer formulation in Ybus, Zbus formulation, Single line representation, per unit calculations of parameters.
Load Flow Analysis: Formation of static load flow equations, solution of decoupled load flow problem by Gauss-Seidel, Newton-Rapson (polar and rectangular) and fast decoupled techniques
Stability of Power system: Introduction, dynamics of synchronous machine, swing equation, swing equation for multi machine system, power angle equation, steady state stability studies.
Transient stability analysis: Swing curve, Swing equations solutions using Runga Kutta method (4th order). Equal area criteria, for transient stability, application of equal area for different disturbance, solution of swing equation point by point methods.
Power System Control: Elementary idea of single area load-frequency control, automatic generation control, Necessity of keeping frequency control, Block diagram representation of an isolated power system, steady state analysis, dynamic response
Voltage control: Equipment for voltage control, Effect of series capacitors, Effect of AVB/AVR, Line drop compensation.
Active power and frequency control: fundamentals of speed governing, control of generating unit power output, composite regulating characteristics of power systems, response rates of turbine governing systems, fundamental of automatic generation control, Implementation of AGC, underfrequency load shedding.
Reactive power and voltage control: Production and absorption of reactive power, method of voltage control,shunt reactors, shunt capacitors, series capacitors, synchronous condensers, static Var system, principle of transmission system compensation, Modelling of reactive compensating devices, Application of tap changing transformers to transmission systems, ULTC control system.
Text Books:
1. Grainger, J.J., Stevenson, W.D., Power System Analysis, 22th ed., McGraw Hill Education (India) Private Limited, New Delhi, 2014.

2. Nagrath, I. J. andKothari, D.P., Power System Engineering, 2nd ed., Tata McGraw Hill Publications, 2013.

Reference Books:

1. Elgerd, O.I., Electric Energy Systems Theory: An Introduction, 2nd ed., Tata Mc-Graw Hill Education, 2012.
2. Saadat, H., Power System Analysis, 3rd ed., PSA Publishing, 2010.

Course Code: **EEL355**
Course Title: **SWITCHGEAR AND PROTECTION**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL256, EEL253, EEL351**

Contents: Faults in Power Supply System: Symmetrical component transformation. **Classification of faults,** Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedance of generator. Transformer transmission line & passive loads. Symmetrical fault analysis without & with prefault load currents. Selection of circuit breakers ratings, current limiting reactors.

Unsymmetrical fault analysis L-G, L-L-G-, L-L, open conductors fault using symmetrical components.

General philosophy of protective relaying: protective zones. Primary protection, back up protection, remote and local back up. Medium voltage line protection: overcurrent relay, directional over current relays.

High voltage line protection: Distance relays, carrier distance schemes. Unit carrier schemes.

Equipment protection: principles of differential relaying, protection of generator, transformers and busbars by differential relaying and other relays. Phase shift in Y/delta three phase transformer (Yd1, Yd11 connection). Protection of induction motor's against overload, short-circuits, thermal release, miniature circuit breaker.

Introduction to numerical relays: Comparison of static and electro-mechanical relays, two input amplitude and phase comparators and their duality. Generation of various distance relay characteristics using above comparators.

Switchgear: circuit breakers, arc interruption theory, recovery and restriking voltages, RRRV, breaking of inductive and capacitive current, different media of arc interruption, SF6 and vacuum breakers. Introduction to Gas Insulated Switchgear and Substation

Text Books:

1. Ram, B. and Vishwakarma, D.N. Power System Protection & Switchgear, 2nded., Tata McGraw Hill, 2013.
2. Paithankar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, 2nd ed., PHI Learning, 2013

Reference Books:

1. Elmore, W.A, Protective Relaying Theory and Applications, 2nd ed., MarcelDekker, New York, 2004.
2. Mason, C.R., Art and Science of Protective Relaying, Wiley, New York, 1968.
3. Warrington, A.R.V., Protective Relays: Their Theory and Practice (Vol. I & Vol. II), 3rd ed., Chapman and Hall, London, 1978.

Course Code: **EEL354**
Course Title: **ADVANCED POWER ELECTRONICS**
Structure (L-T-P): **3-2-0**
Prerequisite: **EEL255**

Contents: The ideal switch; basic switch cell; basic topology rules; possible basic converter topologies: buck, boost, buck-boost; steady-state analysis; dc transformer equivalent.

Switch characteristics of common switches: Power Diodes, SCRs, Power BJTs, GTOs, Power MOSFETs, IGBTs; conduction and switching loss; V-I plane representation of switches; switch realization from basic switch cell; drive requirements for switches; drive circuits; switching aid networks; designing with real switches: switch selection, loss calculation, basics of thermal design.

Effect of non-idealities on converter performance, efficiency, steady-state voltage gain; state space averaging; basics of small signal analysis; ac equivalent circuit.

Control of converters; voltage mode control; review of bode plots; design of converter controls.

Resonant Converters; Parallel loaded and series loaded resonant converters; transfer characteristics; design.

Inverters; basic two-level inverters: topology derivation and switching schemes; PWM methods: sine-triangle and space-phasor methods. Multi-level inverters: basic topology derivation and introduction to PWM schemes for multi-level inverters.

Text Books:

1. Mohan, Ned, Undeland, T.M. and Robbins, W.P., Power Electronics, 3rd ed., Wiley India, 2014.
2. Vithayathil, J., Power Electronics: Principles and Applications, Tata Mc Graw Hill, 2013.

Reference Books:

1. Ericksson, R., and Maksimovic D., Fundamentals of Power Electronics, 2nd ed., Springer, 2013.

Course Code: **EEL351**
Course Title: **ELECTRICAL MACHINES-II**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL253**

Contents: **Three Phase Induction Motor:** principle and operation, types of motors, Three phase speed control of induction motor (V/f control etc.) load torque-speed characteristics, determination of equivalent circuit parameter, circle diagram of induction motor , starting against load, star delta starter, soft starting faults on motor , single phasing & protection. Different types of slots of machines (open, closed, semi closed), Crawling, Cogging, Induction Generator,

Three phase Alternator: constructional features of cylindrical and salient pole rotor machines, steady state operation of three phase synchronous generators, phasor diagram, regulation & efficiency, parallel operation, transient & sub transient reactance's and their measurement, short circuit fault currents. Effects of variable excitation and mechanical power input on generator operation.

Three phase Synchronous Motor: methods of starting, performance and leading power factor operation due to effect of variable excitation and load on motor operation. Study of both cylindrical and salient pole alternator, phasor diagram at various power factor, V curve, capability characteristics etc.

Single phase machines: Induction Motor: principle, equivalent circuit, characteristics, double field revolving theory, staring methods, Repulsion motor, Reluctance motor, Hysteresis motor, Universal motor, Stepper motor.

Text Books:

1. Fitzgerald, A.E., Kingsley, C. and Umans, S.D., Electric Machinery,6th ed., Tata McGraw Hill, 2014
2. Bhimbhra, P.S., Electrical Machinery, Khanna Publishers, Delhi, 2003.
3. Nagrath, I. J. and Kothari, D. P., Electric Machines, Tata McGraw Hill, 2006.

Reference Books:

1. A.S. Langsdorf: Theory of Alternating Current Machinery, Tata Mc-Graw Hill.
2. I.J. Nagrath, D.P. Kothari: Electrical Machines, Tata McGraw Hill.
3. M. G. Say: The Performance and Design of Alternating Current Machines, III Edition, CBS Publishers & Distributers.
4. Toro, V.D., Electric Machines and Power Systems, Prentice Hall, 1985.

Course Code: **EEL451**
Course Title: **COMPUTER CONTROL AND AUTOMATION OF POWER SYSTEMS**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL256**

Contents: Energy Management Systems (EMS): Energy Management Centers and Their Functions, Architectures, recent Developments. Characteristics of Power Generating Units and Economic Dispatch. Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints); Solution techniques of Unit Commitment. Generation Scheduling with Limited Energy. Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations. Interchange Evaluation for Regional Operations, Types of Interchanges. Exchange Costing Techniques.

Supervisory Control and Data Acquisition (SCADA): Introduction to Supervisory Control and Data Acquisition. SCADA Functional requirements and Components. General features, Functions and Applications, Benefits. Configurations of SCADA, RTU (Remote Terminal Units) Connections. Power Systems SCADA and SCADA in Power System Automation. SCADA Communication requirements. SCADA

Communication protocols: Past Present and Future. Structure of a SCADA Communications Protocol.

Text Books:

1. Wood, A. J., Wollenberg, B.F. and Sheble, G.B., Power Generation Operation and Control,3rd ed.,Wiley-Interscience, 2014.
2. Green J.N, Wilson, R,Control and Automation of Electric Power Distribution Systems,CRC Press, 2013.
3. M A Pai, Computer Techniques In Power System Analysis, Mc-Graw Hills
4. G.W. Stagg & A.H. El-Abiad, Computer Methods In Power System Analysis, Mc-Graw Hills

Reference Books:

1. Handschin E. and Petroianu, A., Energy Management Systems: Operationand Control of Electric Energy Transmission Systems, Springer Verlag, 1991.
2. Handschin, E., Real-Time Control of Electric Power Systems, Elsevier, 1972.
3. McDonald, J.D., Electric Power Substations Engineering, 3rd ed., CRC Press, 2012.

Course Code: **EEL452**
Course Title: **DISCRETE DATA AND DIGITAL CONTROL**
Structure (L-T-P): **3-2-0**
Prerequisite: **EEL254**

Contents: Sampling and data reconstruction processes: sampled, Data control systems, Ideal sampler, Sampling theorem, Sample and hold operations, Frequency domain considerations.

Z-transforms: Properties inverse, Applications to solution of difference equations, Convolution sums.

Stability of discrete systems: Location of poles, Jury's stability criterion, Stability analysis through bilinear transforms.

General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems, Dead beat controller, closed loop digital control systems with time delay systems.

Design of digital control systems: PID controllers and frequency domain compensation design.

State variable methods and the discrete linear regulator problem. Deadbeat observer, The Separation Principle, Reduced order observer, Root locus technique.

Text Books:

1. Ogata, K., Discrete Time Control System, 2nd ed., Prentice Hall of India, 2011.
2. Gopal, M., Digital Control Engineering and State Variable Methods: Conventional and Intelligent Control Systems, 4th ed., Tata McGrawHill, 2012.

Reference Books:

1. Isermann, R., Digital Control Systems, 2nd ed., Springer, 1997.
2. Landau, Y.D. and Zito, G., Digital Control Systems: Design, Identification and Implementation, Springer, 2006

Course Code: **EEL453**
Course Title: **POWER PLANT ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL253, EEL256**

Contents: Conventional Sources of electrical energy: Steam, hydro, nuclear, diesel and gas, their scope and potentialities for energy conversion.

Generation: Different factors connected with a generating station, load curve, load duration curve, energy load curve, base load and peak load plants.

Thermal stations: Selection of site, size and no. of units, general layout, major parts, auxiliaries, generation costs of steam stations.

Hydro stations: Selection of site, mass curve, flow duration curve, hydrograph, classification of hydro plants, types of hydro turbines, pumped storage plants.

Nuclear stations: Main parts, location, principle of nuclear energy, types of nuclear reactors, reactor control, nuclear waste disposal.

Power station control and interconnection: Excitation systems, excitation control, automatic voltage regulator action, advantage of interconnection.

Alternate energy sources: Solar, wind, geo-thermal, ocean-thermal, tidal wave, MHD and biomass.

Text Books:

1. Deshpande, M.V., Elements of Electrical Power Station Design, 5th ed., PHI, 2013.
2. Gupta, B.R., Generation of Electrical Energy, S. Chand, New Delhi, 2013.

Reference Books:

1. Nag, P.K., Power Plant Engineering, 3rd ed., Tata Mc-Graw Hill Education, 2013.
2. Raja, A.K., Srivastava, A.P. and Dwivedi, M., Power Plant Engineering, New Age International Private Limited, New Delhi, 2006.

Course Code: **EEL454**
Course Title: **HVDC**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL255**

Contents: Evolution of HVDC Transmission, Comparison of HVAC and HVDC systems, Type of HVDC Transmission systems, Components of HVDC transmission systems, Analysis of simple rectifier circuits, Required features of rectification circuits for HVDC transmission, Analysis of HVDC converter, Different modes of converter operation, Output voltage waveforms and DC voltage in rectification, Output voltage waveforms and DC in inverter operation, Thyristor voltages, Equivalent electrical circuit, HVDC system control features,Control Modes, Control Schemes, Control comparisons.

Converter mal-operations, Commutation failure, Starting and shutting down the converter bridge, Converter protection.

Smoothing reactor and DC Lines, Reactive power requirements, Harmonic analysis, Filter design.

Component Models for the Analysis of AC DC Systems, Power flow analysis of AC-DC systems, Transient stability analysis, Dynamic stability analysis.

Multi-terminal HVDC system, Advances in HVDC transmission, HVDC system application in wind power generation.

Text Books:

1. Padiyar, K.R., HVDC Power Transmission Systems, 2nd ed., New Age International, 2013.
2. Kimbark, E.W., Direct Current Transmission, Wiley-Interscience, New York, 1971.

Reference Books:

1. Singh, S.N., Electric Power Generation, Transmission and Distribution, 2nd ed., PHI Learning, New Delhi, 2010.
2. Arrillaga, J., High Voltage Direct Current Transmission, 2nd ed., Institution of Engineering and Technology, London, 2008.

Course Code: **EEL 455**
Course Title: **POWER SYSTEM ECONOMICS & MANAGEMENT**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL256**

Contents: Economic Operation of Power Systems: Optimal operation of Generators in Thermal Power Stations, Heat rate Curve, Cost Curve, Incremental fuel and Production costs, input-output characteristics, Optimum Generation allocation with line losses neglected.

Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

Hydrothermal Scheduling: Optimal scheduling of Hydrothermal System: Hydroelectric Power plant models, Scheduling problems-short term Hydrothermal scheduling problem.

Modeling of Turbine, Generator and Automatic Controllers: Modelling of Turbine: First order Turbine, model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

Modelling of Generator (Steady State and Transient Models): Description of Simplified Network Model of a Synchronous Machine (Classical Model), Description of Swing Equation (No Derivation) and State-Space II-Order Mathematical Model of Synchronous Machine.

Modelling of Governor: Mathematical Modelling of Speed Governing System – Derivation of Small signal transfer function. Modelling of Excitation System: Fundamental Characteristics of an Excitation system, Ttransfer function, Block Diagram Representation of IEEE Type-1 Model

Single Area Load Frequency Control: Necessity of keeping frequency constant. Definitions of Control area, Single area control, Block diagram

representation of an isolated power system, steady state analysis, Dynamic response, Uncontrolled case.

Two-area load frequency control:

Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias control.

Load Frequency Controllers:

Proportional plus Integral control of single area and its block diagram representation, steady state response – Load Frequency Control and Economic, Dispatch control.

Reactive Power Control: Overview of Reactive Power control, Reactive Power compensation in transmission systems, advantages and disadvantages of different types of compensating equipment for transmission systems, load compensation, Specifications of load compensator, Uncompensated and compensated transmission lines, shunt and Series Compensation.

Text Books:

1. Kundur P., Power System Stability and Control, EPRI Series, McGraw-Hill, 1998.
2. Wood A. J. and Wollenberg B. F., Power Generation, Operation and Control, second edition, Willey Publication, 2008.

Reference Books:

1. Nagrath I. J. and Kothari D. P., "Power System Engineering", 2nd edition, Tata Mc-Graw Hill Publishing Company,2008.
2. Saadat H., Power System Analysis, 1st International Edition, Tata McGraw-Hill Publishing Company Limited, 2008

Course Code: **EEL456**
Course Title: **SYSTEM ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Introduction to Optimization, Generalized Principles of System Modeling, Engineering Applications of Optimization, Statement of problem, Classification of optimization problem techniques.

Linear programming, introduction, Requirements for a LP Problem, Graphical solution of 2-variable LP problems, Some exceptional cases, General mathematical formulation for LPP, Canonical and standard forms of LP problem, Simplex method, special cases in simplex method, Big-M method, Concept of duality, Dual simplex method and sensitivity analysis.

Transportation problem, Definition and mathematical representation of transportation model, Formulation and solution of transportation models (basic feasible solution by north-west corner method, Inspection method, Vogell's approximation method).

Network models, Scope and definition of network models, Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model.

Goal programming, Formulation of goal programming, Introduction to goal programming algorithms, The weights method, The preemptive method.

Text Book:

1. Hamdy A. Taha, Operations Research: An Introduction, Pearson, 9th Ed., 2014.

Reference Books:

1. S. S. Rao, Engineering Optimization: Theory and Practice, 4th Ed., John Wiley & Sons, 2009.
2. G. Hadley, Linear Algebra, Narosa, 2002.
3. P. K. Gupta and D. S. Hira, Operations Research, S. Chand Publications, 7th Ed., 1976.

Course Code: **EEL457**
Course Title: **Pulse Width Modulation for Power Converters**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL255**
Contents: Introduction: Review of Voltage Source Inverters and Multi-level Inverters.

Harmonic Distortion: Voltage and Current Distortion Factors and Weighted THD calculation by using Fourier series for different level Voltage Source Inverters.

Pulse width modulation (PWM) at low switching frequency: Square wave operation of voltage source inverter; PWM with a few switching angles per quarter cycle; equal voltage contours; selective harmonic elimination.

Triangle-comparison based PWM: Average pole voltages, sinusoidal modulation, third harmonic injection, continuous PWM, bus-clamping or discontinuous PWM; Extensions of sine-triangle PWM to multilevel inverters.

Space Vector Based PWM: Space vector concept and transformation, per-phase methods from a space vector perspective, space vector based modulation, conventional space vector PWM, bus-clamping PWM, advanced PWM, triangle-comparison approach versus space vector approach to PWM, Extensions of space vector based PWM to multilevel inverters.

Inverter loss: Evaluation of conduction loss, Dependence of switching loss on power factor and modulation method, PWM techniques for reduced switching loss.

Effect of inverter dead-time: Effect of dead-time with continuous modulation, Effect of dead-time with discontinuous or bus-clamping PWM.

Text books:

1. Mohan N., Underland T.M., Robbins W.P., "Power Electronics – Converters, Applications and Design", John Wiley & Sons Inc., 2004.
2. Erickson R. W., Maksimovic D., "Fundamentals of Power Electronics", Springer (India) Pvt. Ltd., 2005.
3. Rashid M. H., "Power Electronics: Circuits, Devices and Applications", Third Edition, Pearson, 2009.

Reference books:

1. Choi Byungcho, "Pulsewidth Modulated DC to DC Power Conversion: Circuits, Dynamics and Control Designs", IEEE Press, John Wiley & Sons, Inc., 2013.
2. Holmes D.G., Lipo T.A., "Pulse Width Modulator for Power Converters – Principles and Practice", IEEE Press, John Wiley & Sons, Inc., 2003.

Course Code: **EEL458**
Course Title: **SOFT COMPUTING TECHNIQUES**
Structure (L-T-P): **3-0-0**
Prerequisite: **SCL152, SCL153**
Contents: Introduction, brief history of artificial intelligence, comparison with deterministic methods, aims, objectives of artificial intelligence and current state of the art.

Expert systems: introduction to knowledge based systems structure and definitions knowledge acquisition inference engine, forward and backward chaining.

Fuzzy logic: introduction to concepts, fuzzy reasoning, defuzzification, adaptive fuzzy systems.

Artificial neural networks: basic concepts, introduction to various paradigms, learning in neural networks, back-propagation, multi-layer networks,

Evolutionary computing (Genetic algorithms): basic concepts, Genetic algorithms and variants,

Differential evolution, Particle swarm optimization (PSO) and variants, Bacterial foraging optimization (BFO), Ant colony optimization - travelling salesman problem, cat swarm optimization.

Applications of AI in Electrical Engineering like condition monitoring, protective relaying etc.

Text Books:

1. Zurada, J.M., Introduction to Artificial Neural Systems, Jaico Publication House, 2006.
2. Haykin, S.S., Neural Networks and Learning Machines, 3rd ed., PHI Learning, 2013.
3. Lotfi A. Zadeh (Advances in Fuzzy Systems: Application and Theory) First Edition,

Reference Books:

1. Deb, K., Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley and Sons, 2009.
2. Hagan, M.T., Demuth, H.B. and Beale, M.H., Neural Network Design, Vikas Publishing House, New Delhi, 2004.
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications Paperback – Import, 8 May 2017
4. Lefteri H. Tsoukalas, Robert E. Uhrig, Lotfi A. Zadeh, Fuzzy And Neural Approaches in Engineering.

Course Code: EEL459
Course Title: COMMISSIONING AND TESTING OF ELECTRICAL SYSTEMS
Structure (L-T-P): 3-0-0
Prerequisite: EEL151, EEL253, EEL351
Contents: **Installation of Electrical Equipment:** Inspection of Electrical Equipment at site, Storage Electrical Equipment at site, Foundation of Electrical Equipment at site, Alignment of Electrical Machines, Tools/Instruments necessary for installation, Technical report, Inspection, storage and handling of transformer, switchgear and motors.
Testing of Transformer, Plant and Equipment:
General Requirements for Type, Routine and Special Tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation resistance; Dielectric tests; Temperature-rise, insulation and HV test, dielectric absorption, switching impulse test. Testing of Current Transformer and Voltage Transformer, power transformer, distribution transformer, CVT and special transformer with reference to Indian Standard (IS). Drying out procedure for transformer. PI index, Commissioning steps for transformer, Troubleshooting &
Maintenance of transformer. [Ref: IS 2026:Part_1-10- Power Transformers: Methods of Test; IS 13956:1994Testing Transformers]
Installation and Commissioning of Rotating Electrical Machines: Degree of protection, cooling system, degree of cooling with IP- IC code (brief discussion), enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of induction motor and rotating electric machine, drying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator, protection and automation of synchronous generator, synchronous motor, D.C. generator and motor with reference to Indian Standard (IS). [Ref: IS 4029:2010-Guide for Testing Three Phase Induction Motors; IS 7132:1973-Guide for Testing Synchronous Machines; IS 9320:1979-Guide for Testing of Direct Current (dc) Machines]
Transmission line:
Commissioning of A.C transmission line and HVDC transmission, galvanize steel structure, towers and insulator for transmission and distribution line, tower footing resistance, substation equipment, bus bar system, power cable, low power control cable, Contactor, GIS (gas insulated substation).
SWITCH GEAR & PROTECTIVE DEVICES
Standards, Classification, specification, rating and duties of CB, installation, commissioning tests, maintenance schedule, type & routine tests. Operation of s/s (steps) for line Circuit breaker maintenance. Location of lightening arrester with reasons
Text books:
1. S. Rao, Testing Commissioning Operation & Maintenance of Electrical Equipments , 6th Ed , Khanna Publishers Delhi, 2010.
2. P. Gill, Electrical Power Equipment Maintenance and Testing, 2nd Ed., CRC Press (Taylor & Francis Group), 2009.

Reference Books:
1. T. Singh, Installation commissioning & Maintenance of Electrical Equipments, S. K. Kataria and Sons, New Delhi, 2013.
2. P. Kiameh, Electrical Equipment Handbook: Troubleshooting & Maintenance, 1st Ed., McGraw-Hill Companies, Inc, 2003.

Course Code: EEL460
Course Title: CONTROL SYSTEM DESIGN
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Introduction to design: state-space models, performance measures like ISE, ITAE, quadratic indices, controllability and observability. Linear Quadratic Regulator (LQR), performance index, optimal control law, algebraic riccati equation, frequency-domain interpretation. Linear Quadratic Gaussian (LQG): statistical descriptions of noise, Kalman filter, stability margins. H design, uncertainty descriptions, robustness measures, formulation for control-synthesis, riccati equation, and model-order reduction. Case studies, inverted pendulum, missile guidance, process control. Software based design of industrial controllers.
Text Books:
1. Dorf, R.C., Modern Control System, 11th ed., Pearson Education, 2013.
2. Nise, N., Control System Engineering, 6th ed., John Wiley & Sons, 2013.

Reference Books:
1. Anderson, B.D.O. and Moore, J.B., Optimal Control: Linear Quadratic
   Methods, Dover Publications, 2007
2. Friedland, B., Control System Design: An Introduction to State-Space
   Methods, Dover Publications, 2012
3. Doyle, J.C., Francis, B.A. and Tannenbaum, A.R., Feedback Control Theory, Dover Publications, 2009.

Course Code: EEL461
Course Title: ELECTRICAL ENERGY SYSTEM
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: **Introduction**, Fossil fuel based systems, Impact of fossil fuel based systems, Non-conventional energy, seasonal variations and availability, Renewable energy, sources and features, Hybrid energy systems, distributed energy systems and dispersed generation (DG)
Solar thermal systems: Solar radiation spectrum, Radiation measurement, Technologies, Applications, Heating, Cooling, Drying, Distillation, Power generation.
Solar Photovoltaic systems: Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications, Battery charging, Pumping, Lighting, Peltier cooling.
Microhydel: Operating principle, Components of a microhydel power plant, Types and characteristics of turbines, Selection and modification, Load balancing.
Wind: Wind patterns and wind data, Site selection, Types of wind mills, Characteristics of wind generators, Load matching.
Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, electric and hybrid electric vehicles.
Tariffs and cost of energy under regulated and de-regulated environment, Energy audit and its methodologies.
Text Books:
1. Rai, G.D., Non-Conventional Energy Sources, 5th ed., New Age International, 2013.
2. Ramesh, R., Renewable Energy Technologies: Ocean Thermal Energy Conversion and other Sustainable Energy Options, Narosa, New Delhi, 1997.

Reference Book:
1. Vanek, F.M., Albright, L.D. and Angenent, L.T., Energy Systems Engineering: Evaluation and Implementation, 2nd ed., Tata McGraw Hill, 2012.

Course Code: 462
Course Title: ELECTRICAL DISTRIBUTION SYSTEM
Structure (L-T-P): 3-0-0
Prerequisite: EEL256
Contents: General concepts: Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, Contribution factor loss factor-relationship between the load factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and industrial) and their characteristics.
Distribution feeders: Design consideration of distribution feeders: Radial and loop types of primary feeders, Voltage levels, Feeder loading; Basic design practice of the secondary distribution system. Substations: location of substation, Rating of distribution substation, Service area within primary feeders. Benefits derived through optimal location of substations.
Underground Cables :Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted Cable, Breakdown of Cables, Cable Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables.
System Analysis: Voltage drop and power-loss calculations, Derivation for voltage drop and power loss in lines, Manual methods of solution for radial networks, Three phase balanced primary lines.

Protection: Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective devices: Principle of operation off uses, Circuit re-closures, Line sectionalizes, and Circuit breakers.
Coordination: Coordination of protective devices: General coordination procedure. Compensation for power factor improvement, Capacitive compensation for power-factor control. Different types of power capacitors, Shunt and series capacitors, Effect of shunt capacitors (fixed and switched), Power factor correction, Capacitor allocation-economic justification, Procedure to determine the best capacitor location.
Voltage control: Equipment for voltage control, Effect of series capacitors, Effect of AVB/AVR, Line drop compensation.

Text Books:

1. Gonen, T., Electric Power Distribution System Engineering, 3rd ed., CRC Press 2014.
2. Pabla, A.S., Electric Power Distribution, 6th ed., Tata McGraw Hill, 2012.

Reference Books:

1. Sivanagaraju, S. and Sankar, V., Electrical Power Distribution and Automation, Dhanpat Rai & Co, 2006.
2. Kamaraju, V., Electrical Power Distribution Systems, Tata McGraw Hill Education, New Delhi, 2011.

Course Code: **EEL463**
Course Title: **HIGH VOLTAGE ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL256, EEL353**
Contents: Levels of high voltage, votage levels, electrical insulation and dielectrics, importance of electric field intensity in the dielectrics, types of electric fields and degree of uniformity of fields, utilization of dielectric properties and stress control.
Properties of atmospheric air, SF6 and vacuum, relate dionization process, properties in vacuum, related ionization process, development of electron Avalanche, breakdown mechanisms, Townsend's mechanism, breakdown mechanisms, streamer mechanism, breakdown in uniform fields (Paschen's law), breakdown of gaseous dielectrics in weakly non-uniform and the limiting value of Î, development of PB in extremely non-uniform fields, breakdown characteristics in air with stable PB (corona).
Classification and properties of liquid dielectrics, classification and properties of solid dielectrics, classification and properties of liquid dielectrics, classification and properties of solid dielectrics, insulation resistance, conductivity and losses in dielectrics, partial breakdown phenomenon in dielectrics, partial breakdown phenomenon on the surfaces of solid and liquid dielectrics and degradation due to PB.
Definition and measurements of intrinsic and practical breakdown strengths of liquid dielectrics, measurement of intrinsic breakdown in solid dielectrics, thermal and other breakdown mechanisms in extremely non-uniform fields, comparison of the development of breakdown in extremely and weakly non-uniform fields and the requirement of time for breakdown in solid dielectrics.
methods of generation of power frequency high test voltage, transformers in cascade, resonance transformers, g generation of high DC voltage, voltage multiplier circuits and ripple minimization, sources of overvoltages and standard lightning and switching wave shapes, impulse voltage generator, analysis of single stage circuit, multistage impulse generator and their triggering methods.
Peak high voltage measurement techniques, sphere gap, construction, effects of earthed objects and atmospheric conditions, electrostatic voltmeters, principle and construction.
Potential dividers, their types and applications.
Measurable properties of dielectrics, measurement of dielectric properties with Schering bridge and Mega ohm meter, partial breakdown (PB), measurement techniques in dielectrics/ equipment. Over voltages and basic insulation level design systems.

Text Book:

1. Naidu, M. S. and Kamaraju, V., High Voltage Engineering, 4th edition, Tata McGraw-Hill, New Delhi, 2008.

Reference Books:

1. Kuffel J., Kuffel E., and Zaengl W. S., High Voltage Engineering fundamentals, 2nd edition, Newness (Oxford, Boston), 2000.
2. Abdel-salam M., Anis H. and, Abdel-salamani, High Voltage Engineering: Theory and Practice, 2nd edition, CRC Press, 2001.
3. Ray S., An introduction to High Voltage Engineering, Prentice Hall, New Delhi, India, 2004

Course Code: **EEL464**
Course Title: **POWER QUALITY ISSUES AND SOLUTION**
Structure (L-T-P): **3-0-0**
Prerequisite: **EEL151, EEL255**
Contents: Definitions of various powers, power factor and other figures of merit under balanced, unbalanced and nonsinusoidal conditions.
Definitions of various powers, power factor, SINGLE PHASE CIRCUITS: Sinusoidal Voltage Source Supplying Non-linear Load Current, Non-sinusoidal Voltage Source Supplying Non-linear Loads.
THREE PHASE CIRCUITS: POWER DEFINITIONS AND VARIOUS COMPONENTS: Three-phase Sinusoidal Balanced System, Instantaneous Active and Reactive Powers for Three-phase Circuits: Three-Phase Balance System, Three-Phase Unbalance System, Three-phase Non-sinusoidal Balanced System, Unbalanced and Non-sinusoidal Three-phase System
FUNDAMENTAL THEORY OF LOAD COMPENSATION, Phase Balancing and Power Factor Correction of Unbalanced Loads, A Generalized Approach for Load Compensation using Symmetrical Components , CONTROL THEORIES FOR LOAD COMPENSATION
Harmonics: voltage and current harmonics distortions, harmonics of single-phase power supplies, effects of harmonics distortion, system response characteristics, locating sources of harmonics, peripherals for controlling harmonics, devices for filtering harmonics distortion, harmonics study procedure, symmetrical components, modeling harmonics sources, harmonic filter design, telecommunication interferences, computer tools for harmonic analysis.
Voltage Sag, Compensators to mitigate power quality related Problems, series and shunt compensation, Description of static VAR compensators (SVC), Detailed modeling, analysis and design aspects of custom power devices (DSTATCOM, DVR).

Text Books:

1. Kennedy, B.W., Power Quality Primer, Mc-Graw Hill, 2000.
2. Dugan, R.C. and et.al., Electrical Power Systems Quality, 3rd ed., Tata McGraw Hill, 2012.

Reference Book:

1. Kazibwe, W.E. and Sendaula, M.H., Electric Power Quality Control Techniques, Van Nostrand Reinhold, 1993.

Course Code: **EEL 465**
Course Title: **ELECTRICAL ENGINEERING MATERIAL**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Introduction to engineering materials, crystal structures and defects, ceramic materials, dielectric properties of insulators in static fields, dielectric properties of insulators in alternating field, insulating materials and their applications, Dielectric breakdown, magnetic materials – basics, properties and applications, ferrites, ferro-magnetic materials and components; basics of solid state physics, conductors, Photo-conductivity, optical properties of materials, Basics of Nano materials and Superconductors

Text books:

1. S.P.Seth, “A Course in Electrical Engineering Materials”, Dhanpat Rai Publications, 3rd edition, 2011.
2. N Alagappan, N Kumar, “Electrical Engineering Materials”, Tata McGraw Hill, 2017

Reference Book:

1. A.J.Dekker, “Electrical Engineering Materials”, Prentice-Hall Of India Pvt Ltd , 2011.

Course Code: **EEL466**
Course Title: **POWER SYSTEM OPERATION AND CONTROL**
Structure (L-T-P): **3-2-0**
Prerequisite: **EEL256, EEL353**
Contents: Economic Operation of Power Systems: Optimal operation of Generators in Thermal Power Stations, Heat rate curve, Cost curve, Incremental fuel and production costs, input-output characteristics, Optimum Generation allocation with line losses neglected.
Optimum generation allocation including the effect of transmission line losses, Loss coefficients, General transmission line loss formula.

Hydrothermal Scheduling: Optimal scheduling of Hydrothermal System: Hydroelectric Power Plant models, scheduling problems-short term Hydrothermal scheduling problem.

Unit commitment, constraints in unit commitment, Solution methods: priority list method, Mixed Integer Linear Programming, Dynamic programming method and Lagrange relaxation methods.

Introduction to Single Area load frequency control

Two area load frequency control: Load frequency control of 2 area system-uncontrolled case and controlled case, tie line bias control.

Load frequency controllers: Proportional plus Integral control of single area and its block diagram representation, steady state response-Load frequency control and Economic dispatch control.

Optimal power flow formulation, gradient and Newton method, linear programming methods.

Reactive power control: Overview of reactive power control, Reactive power compensation in transmission systems, advantages and disadvantages of different types of compensating equipment for transmission systems, load compensation, Specifications of load compensator, Uncompensated and compensated transmission lines, shunt and series compensation.

Text Books:

1. Wood. A. J. and Wollenberg B. F., Power Generation, Operation and Control, 3rd edition, Willey Publication, 2014.
2. P.S.R. Murty, Operation and control in power systems, 2nd edition, BS Publications, 2009.

Reference Books:

1. Kundur P., Power System Stability and Control, EPRI Series, McGraw- Hill, 1998.
2. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, 4th edition, Mc-GrawHill Education, 2011.

B.Tech (Electronics and Communication Engineering)
OVERALL CREDIT STRUCTURE

Undergraduate Core (UG)		Undergraduate Elective (UE)	
Category	Credit	Category	Credit
DC	67	DE	23 (minimum)
BS	19	HM	06 (minimum)
ES	22	OC	18 (Balance)
HM	05	UN	00 (03 Course)
Total	113	Total	47
Grand Total (UC+UE)			**160**

Basic Science (BS)			
Course Code	**Course**	**L-T-P**	**Credit**
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL253	Probability & Numerical Methods*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)			
Course Code	**Course**	**L-T-P**	**Credit**
HMP152	Technical Communication	2-0-2	03
HML151	Social Science	2-0-0	02
Total			**05**

Engineering Arts and Science (ES)			
Course Code	**Course**	**L-T-P**	**Credit**
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
ECL151	Basic Electronics Engineering	3-0-0	03
ECP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	3-0-0	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	1
CEL151	Environmental Science	2-0-0	2
Total			**22**

Non Credit Requirement (UN)			
Course Code	**Course**	**L-T-P**	**Credit**
NCN151	NCC#	-	0
NCN152	NSS#	-	0
NCN153	NSO#	-	0
SPB151	Sports-I#	0-0-4	0
SPB152	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
ECT251	Practical Training	-	0

 # A Student has opt at least one from NCC, NSS, NSO and Sports (I&II both).

Departmental Core (DC)		L-T-P	Credit
ECL251	Signals and Systems*	3-2-0	04
ECL252	Analog Circuits*	3-0-0	03
ECP252	Analog Circuits Lab*	0-0-2	01
ECL253	Analog Communication Systems*	3-0-0	03
ECP253	Analog Communication Systems Lab*	0-0-2	01
EEL251	Basic Electrical Circuits*	3-0-0	03
EEP251	Basic Electrical Circuits Lab*	0-0-2	01
EEL252	Measurement & Instrumentation**	3-0-0	03
EEP252	Measurement & Instrumentation Lab**	0-0-2	01
EEL254	Control System**	3-0-0	03
EEP254	Control System Lab **	0-0-2	01
ECL254	Engineering Electromagnetics*	3-0-0	03
ECL255	Solid State Devices	3-0-0	03
ECL256	Digital Circuits*	3-0-0	03
ECP256	Digital Circuits Lab*	0-0-2	01
ECL351	Linear Integrated Circuits***	3-0-0	03
ECP351	Linear Integrated Circuits Lab***	0-0-2	01
ECL352	Digital Signal Processing***	3-0-0	03
ECP352	Digital Signal Processing Lab***	0-0-2	01
ECL353	Microcontroller and Interfacing**	3-0-0	03
ECP353	Microcontroller and Interfacing Lab**	0-0-2	01
ECL354	Antenna Theory**	3-0-0	03
ECL355	Digital Communication Systems***	3-0-0	03
ECP355	Digital Communication Systems Lab***	0-0-2	01
ECL356	Microwave Theory and Techniques***	3-0-0	03
ECP356	Microwave Theory and Techniques Lab***	0-0-2	01
ECL357	Information Theory & Coding***	3-0-0	03
CSL251	Data Structures **	3-0-0	03
CSP251	Data Structures Lab	0-0-2	01
ECD351	Minor Project	-	01
ECD451	Major Project	-	02

Department Elective (DE)		L-T-P	Credit
ECL461	Wireless Communications	3-0-0	03
ECP461	Wireless Communications Lab	0-0-2	01
ECL462	Electronic System Design	3-0-0	03
ECP462	Electronic System Design Lab	0-0-2	01
ECL463	Optical Communication Systems	3-0-0	03
ECL464	Radar Systems	3-0-0	03
ECL465	Satellite Communication Systems	3-0-0	03
ECL466	Finite Automata	3-0-0	03
ECL467	Radio Frequency and Microwave Engineering	3-0-0	03
ECL468	Embedded System Design	3-0-0	03
ECP468	Embedded System Design Lab	0-0-2	01
ECL469	Hardware Description Languages	3-0-0	03
ECP469	Hardware Description Languages Lab	0-0-2	01
ECL562	Principles of Biomedical Instrumentation Design	3-0-0	03
CSL258	Computer Organization	3-0-0	03
CSP255	Computer Networks Lab	0-0-2	01
CSL255	Computer Networks	3-0-0	03
CSP256	Software Lab	0-0-2	01
CSL355	Artificial Intelligence	3-0-0	03
CSP355	Artificial Intelligence Lab	0-0-4	02
CSL351	Database Management Systems	3-0-0	03
CSP351	DBMS Lab	0-0-2	01
CSP353	Python Lab	0-0-2	01
CSL354	Information and Network Security	3-0-0	03
CSP452	Cloud Computing Lab	0-0-4	02
CSL359	Neuro-Fuzzy Techniques	3-0-0	03

CSL451	Real Time Systems	3-0-0	03
CSP451	Real Time Systems Lab	0-0-4	02
CSP455	Linux lab	0-0-4	02
CSL453	Internet of Things	3-0-0	03
CSP453	IoT Lab	0-0-6	03
CSL456	Multimedia Technologies	3-0-0	03
CSP355	Artificial Intelligence Lab	0-0-6	03
EEL255	Power Electronics	3-0-0	03
EEL354	Advance Power Electronics	3-0-0	03
EEP354	Power Electronics Lab	0-0-2	01
SCL354	Nanoscience and Nanotechnology	3-0-0	03
SCL457	Semiconductor Materials and Optoelectronics	3-0-0	03
SCL458	Magnetic Materials and Devices	3-0-0	03
ECL502	MOS Device Physics	3-0-0	03
ECL503	CMOS Digital VLSI Design	3-0-0	03
ECP503	CMOS Digital VLSI Design Lab	0-0-2	01
ECL504	CMOS Analog VLSI Design	3-0-0	03
ECP504	CMOS Analog VLSI Design Lab	0-0-2	01
ECL519	VLSI/ULSI Technology	3-0-0	03
ECL520	Micro-electromechanical Systems	3-0-0	03
ECL521	Internet of Things	3-0-0	03
ECL542	Image Processing	3-0-0	03
ECP542	Image Processing Lab	0-0-2	01
ECL545	Human and Machine Speech Communications	3-0-0	03
ECP545	Human and Machine Speech Communications Lab	0-0-2	01
ECL551	Adaptive Signal Processing	3-0-0	03
ECL552	Introduction to Machine Learning	3-0-0	03
ECP552	Machine Learning Lab	0-0-2	01

Course Syllabi (Under Graduate)
Department of Electronics Engineering

Course Code: **ECL151**
Course Title: **BASIC ELECTRONICS ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: **Basic Semiconductor Physics:** temperature effect, intrinsic and extrinsic semiconductor, band diagram, mobility, conductivity hall effect, Diode, Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Zener Diodes breakdown mechanism (Zener and avalanche).

Diode Applications: Parallel and Series Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits**.** Light-Emitting Diodes, Varactor (Varicap) Diodes, Tunnel Diodes, Liquid-Crystal diodes and displays.

Transistor Theory: Bipolar Junction Transistor, Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration. Amplifiers. Field Effect Transistor: Construction and I-V Characteristics of JFETs. Construction and I-V Characteristics of MOSFET, CS, CD, CG amplifier and analysis of CS amplifier MOSFET (Depletion and Enhancement) Type.

Digital Electronics: Introduction to digital electronics, Number Systems, Conversion between various number systems, Basic Logic gates.

Operational Amplifiers: Introduction, Differential Amplifier Circuits, Op-Amp Basic, Practical Op-Amp Circuits (Inverting Amplifier, Non-inverting Amplifier, Unit Follower, Summing Amplifier, Integrator, Differentiator). Differential and Common-Mode Operation.

Fundamentals of Communication Engineering: Elements of a Communication System, Need of modulation, electromagnetic spectrum and typical applications, terminologies in communication systems, Basics of signal representation and analysis, Fundamentals of amplitude and angle modulation, modulation and demodulation techniques.

Text Books

1. Robert L. Boylestad & Louis Nashelsky. *Electronic Devices and Circuit Theory*, Tenth Edition, Pearson Education, 2013.
2. David A. Bell, *Electronics Devices and Circuits*, 5th Edition, OXFORD University Press 2008.
3. George Kennedy, *Electronic Communication System*, Fifth Edition, TMH Publication, 2012.

Reference Books

1. Jacob Millman, Christos C. Halkias, Satyabrata Jit, *Electronics Devices and Circuits*, 3rd Edition, TMH 2008.
2. H S Kalsi, *Electronics Instrumentation*, Third Edition, TMH Publication 2012.

Course Code: **ECL251**
Course Title: **Signals and Systems**
Structure (L-T-P): 3-2-0
Prerequisite: NIL
Contents:

Introduction to Signals and Systems, Signal Properties, Convolution of Signals, System properties, Linear Shift Invariant Systems and their Properties and representation

Introduction to Transforms, Fourier series and Fourier Transform, Convergence of Fourier Transform, Properties of Fourier Transform.

Sampling theorem, Sampling/reconstruction of Signals, Realistic sampling, Aliasing. Introduction to Digital Signal Processing, Discrete Time Fourier Transform and Properties.

Introduction to Laplace Transform, Single-sided and double-sided Laplace, Z-Transform, Region of Convergence, Properties of Laplace and Z Transform, Inverse Laplace and Z Transforms, Rational System Functions.

Part of tutorials will be based on MATLAB.

Text Books:

1. B. P. Iathi, Oxford, *Principles of Linear Systems and Signals*, Second edition, 2009.
2. Oppenheim, A.V., Willsky, A.S., and Nawab, S.H. *Signals and Systems*. 2nd ed., PHI Learning Private Limited., 2012.
3. Haykin, S.S. and Veen, B.V. *Signals and Systems* .2nd ed. Wiley, 2013.

Reference Books:

1. Phillips, C.L., Parr, J.M., and Riskin, E.A. *Signals, Systems and Transforms*.5th ed. Pearson Education, 2014.
2. Carlson, G.E. *Signal and Linear System Analysis*. 2nd ed. Allied Publishers Limited, 1993.

Course Code: ECL252
Course Title: Analog Circuits
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Introduction: Scope and applications of analog electronic circuits. Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations(such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of volt-age gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascade amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Collpits, Clapp etc.), non-sinusoidal oscillators, multivibrators.

Text Books:

1. Sedra, A.S. and Smith, K.C., *Microelectronic Circuits: Theory and Applications*, 6th ed., Oxford University Press, 2013.
2. Boylestad, R.L. and Nashelsky, L., *Electronic Devices and Circuit Theory*, 10th ed., Pearson Education, 2013.

Reference Books:

1. Bell, D.A., *Electronic Devices and Circuits*, 4th ed. Prentice Hall of India, 2001.
2. Meade, R.L., *Foundations of Electronics Circuits and Devices*, 5th ed. Delmar Learning, 2007.
3. Horowitz, P. and Hill, W., *The Art of Electronics*, 3rd ed., Cambridge University Press, 2011.
4. Wait, J.V., Huelsman, L. P. and Korn, G.A., *Introduction to Operational Amplifier Theory and Applications*, 2nd ed., Tata McGraw Hill, 1992.
5. M]illman, J., *Microelectronics*, 2nd ed., Tata McGraw Hill, New Delhi, 2003.
6. Gray, P.R.et. al., *Analysis and Design of Analog Integrated Circuits*, 5th ed., John Wiley, 2010.

Course Code: ECL253

Course Title: Analog Communication Systems
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Review of Signal analysis using Fourier transform, analysis of linear time in-variant systems and basic analog ideal filters. Transmission of signals through systems, criteria for distortion less transmission, distortions in practical systems, power and energy of signals. Review of random process and noise.

Amplitude modulation: Need of modulation, AM, DSB-SC, SSB-SC and vestigial side band modulation and demodulation, AM transmitter (broadcast and low power), FDM. Angle modulation: FM and PM, reactance FET modulator Armstrong method, Foster-Seely discriminator, PLL detector, Stereophonic FM, Spectrum of FM, narrow band and wide band FM, FM transmitter (broadcast and low power).

Radio receivers: TRF and super-heterodyne receiver, AGC, FM receiver, sensitivity, selectivity, communication receiver and its special features. Realization of communication systems. Noise in analog communication systems.SNR calculations for AM, FM systems. Analog pulse modulation: Sampling theorem, PAM, PWM, PPM, QAM generation & Detection of these pulse modulated signals, TDM

LAB experiments based on subject.

Text Books:

1. Haykin, S.S. and Moher, M., *Introduction to Analog and Digital Communications*, 2nd ed., Wiley, 2012.
2. Lathi, B.P. and Ding, Z., *Modern Digital and Analog Communication Systems*, 4th ed., Oxford University Press, 2012.

Reference Books:

1. Kennedy, G. and Davis, B., *Electronic Communication Systems*, 4th ed., Tata McGraw Hill, 1999.
2. Schoenbeck, R.J., *Electronic Communications: Modulation and Transmission*, 2nd ed., Prentice Hall, 1992.
3. Taub, H., Schilling, D.L. and Saha, G., *Principles of Communication Systems*; 2ndedition, Tata McGraw-Hill, 2008.

Course Code: ECL254
Course Title: Engineering Electromagnetics
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Review of Vector calculus. Review of basic laws of electrostatics: Coulomb's law, Electric field intensity, Field of 'n' point charges, Field of line and sheet of charge. Electric flux density, Gauss's law and it's applications. Divergence and Divergence theorem. Definition of potential difference and potential, Potential of point charge and system of charges. Potential gradient, Energy density in electrostatic field.

Poisson's and Laplace's equations. Current and current density, Continuity of current. Capacitance. Review of basic laws of magneto statics: Biot-Savart and Amperes circuital laws and their applications, Curl, Stoke's theorem. Magnetic flux density, Scalar and Vector magnetic potential. Maxwell's equations in steady electric and magnetic fields. Time varying fields and Maxwell's equations.

Uniform plane waves, wave motion in free space, perfect dielectric, lossy dielectric and good conductor, skin effect. Poynting vector and power considerations. Reflection of uniform plane waves, Standing ratio, boundary conditions.

Transmission lines: S-parameters, telegraphers model of transmission line. Various terminations. Transmission line equations and their solutions. Transmission line parameters, Characteristic impedances, Propagation constant, Attenuation constant, Phase constant, Waveform distortion, Distortion less transmission lines, Loading of transmission lines, Reflection coefficient and VSWR. Equivalent circuits of transmission lines, Transmission lines at radio frequency. Open circuited and short circuited lines, Smith Chart, Stub matching.

Text Books:

1. Hayt, W.H. and Buck, J.A., *Engineering Electromagnetics*, 7th ed., Tata McGraw Hill, 2013.
2. Sadiku, M.N.O., *Principles of Electromagnetics*, 4th ed., Oxford University Press, 2013.
3. Shevgaonkar, R. K. *Electromagnetic waves*. Tata McGraw-Hill Education, 2005.

Reference Books:

1. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*, 2nd ed., Prentice Hall of India, 2013.
2. Rao, N.N., *Elements of Engineering Electromagnetics*, 6th ed., Prentice Hall of India, 2004.
3. Elgerd, O. I., *Electric Energy Systems Theory: An Introduction*, 2nd ed., Tata McGraw-Hill, New Delhi, 2007.

Course Code: ECL255
Course Title: Solid State Devices
Structure (L-T-P): 3-0-0
Prerequisite: Nil
Contents:

Introduction to Quantum Mechanics

Introduction: Evolution and uniqueness of Semiconductor Technology, Equilibrium carrier concentration, Thermal Equilibrium and wave particle duality, intrinsic semiconductor – Bond and band models, Extrinsic semiconductor – Bond and band models

Carrier transport: Random motion Drift and diffusion

Excess carriers: Injection level, Lifetime, Direct and indirect semiconductors

Procedure for analysing semiconductor devices, Basic equations and approximations

P-N Junction: Device structure and fabrication, Equilibrium picture, DC forward and reverse characteristics, Small-signal equivalent circuit, Switching characteristics, Solar cell.

Bipolar Junction Transistor: Device structures and fabrication, Transistor action and amplification, Common emitter DC characteristics

MOS Junction: C-V characteristics, threshold voltage, body effect

Metal Oxide Field Effect Transistor: Device structures and fabrication, Common source DC Characteristics, Small-signal equivalent circuit, Differences between a MOSFET and a BJT

Junction FET and MESFET, Recent Developments, Heterojunction FET, Heterojunction bipolar transistor

Text Books:

1. Millman, J., and Halkias, Christos C. *Integrated Electronics*. Tata McGraw-Hill Education, 1991.
2. Streetman, B.G., and Banerjee, S.K. *Solid state Electronics devices*. 7th ed. Pearson Education, 2014.

Reference Books:

1. Bell, David A. *Electronics Devices and Circuits*. 4th Ed, Prentice Hall India, 2009.
2. Sedra, A. S., and Smith, K.C. *Microelectronics Circuits*. 7th ed. Oxford University Press, 2015.

Course Code: ECL256

Course Title: Digital Circuits
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Motivation for digital systems, number system and codes Set relations, partially ordered sets and lattices. Switching algebra: switching functions, isomorphic systems, electronic gate networks and Boolean algebra. Minimization of switching functions, K map, minimal functions and their properties, QM method, two level minimization. Introduction to synchronous sequential circuits and iterative networks, Sequential circuits – introductory example. The finite-state model – basic definitions, Memory elements and their excitation functions. Synthesis of synchronous sequential circuits, Iterative networks. Decoders, multiplexers, and code converters, adders: ripple and carry look ahead addition. Storage elements, flip-flops and latches: D, T, J/K flip-flops, shift register, counter. Asynchronous and synchronous design using state and excitation tables. Mealy and Moore machines, FSM implementation. Overview of VLSI designs process. PAL, CPLD, FPGA, ASIC structure overview. Introduction of digital circuits using hardware description language (HDL).
Digital circuit families DTL, TTL RTL, MOS, CMOS circuits. Basic CMOS circuits.
Text Books:
1. Mano, M.M. and Ciletti, M.D. *Digital Design: With an Introduction to the Verilog HDL*. 5th ed. Pearson Education, 2013.
2. Kohavi, Z. and Jha, N.K. *Switching and Finite Automata Theory*. 3rd ed. Cambridge University Press, 2013.
3. Thomas L. Floyd ,Pearson Education, Digital Fundamentals,11th ed. , 2014

Reference Books:
1. Palnitkar, S. *Verilog HDL: A guide to Digital Design and Synthesis.* 2nd ed., Pearson, 2013.
2. Brown, S.D. and Vranesic, Z.G. *Fundamentals of Digital Logic with Verilog Design*. 3rd ed. McGraw-Hill, 2013
3. Bhaskar, J. *VHDL Primer*. 3rd ed. Prentice Hall of India, 2011.
4. Kumar, A. Anand. *Fundamentals of Digital Circuits*. PHI Learning Pvt. Ltd., 2003.

Course Code: ECL351
Course Title: Linear Integrated Circuits
Structure (L-T-P): 3-0-0
Prerequisite: ECL252, ECL151
Contents:
Differential amplifier and Opamp design, configurations (FET, BJT). DC & AC analysis, constant current bias, current mirror, cascaded differential amplifier stages, level translator. OPAMP, inverting, non-inverting, differential amplifier configurations, negative feedback, voltage gain, input & output impedance, Bandwidth. Input offset voltage, input bias and offset current, Thermal drift, CMRR, PSRR, Frequency response. Linear applications, DC, ac amplifiers, summing differential amplifier, instrumentation amplifier, V to I and I to V converters, Integrator, Differentiator. First/second order low/ high/ band pass, band reject active filters, All pass filter Phase shift oscillator, Wein bridge oscillator, Square wave and triangular waveform generators. Nonlinear applications, Comparators, Schmitt Trigger, Clipping and Clamping circuits, Absolute value circuits, Peak detectors, Sample and hold circuits, Log and antilog amplifiers. Data Converters (ADC and DAC's), 555 Timer, Voltage Regulator, Phase Locked Loops (PLL).
Text Books:
1. Graeme, J.G., Tobey, G.E., and Huelsman, L.P. *Operational Amplifiers: Design and Applications*. New Delhi: McGraw Hill, 1986
2. R.A. Gayakwad. *Op-amps and Linear Integrated Circuits*. 4th ed., Prentice Hall of India, 2012.

Reference Books:
1. Franco, S. *Design with Operational Amplifiers and Analog Integrated Circuits*. 4th ed., McGraw Hill Education, 2014.
2. Fiore, J.M. *Op amps and Linear Integrated Circuits: Theory and Application*. Delmar Thomson Learning, 2001.
3. Choudhury. Roy D. *Linear integrated Circuits*. 2nd ed. New Age International Publications, 2003.

Course Code: ECL352
Course Title: Digital Signal Processing
Structure (L-T-P): 3-0-0
Prerequisite: ECL251
Contents:
Discrete time signals and systems, Sampling process, Classification of LTI, Discrete time systems, Linear convolution, Inverse systems, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), theorems, DFT symmetry relations, Circular convolution, Linear convolution using DFT, overlap add
method, overlap save method. Fast Fourier Transform (FFT) algorithms, decimation in time and frequency domain and algorithms, Goertzel algorithms Signal flow graph representation, parallel and cascade form. Design of FIR digital filter using window method, Park-McClellans method. Design of IIR digital filter, Butterworth and Chebyshev with bilinear transformation and impulse in-variant method.
Group delay, phase delay and effect of finite word length in FIR filter design. Digital Signal Processors.
Lab experiments based on MATLAB and DSP processor kits.
Text Books:
1. Oppenheim, A.V. and Schafer, R.W., *Discrete-Time Signal Processing,* 3rd ed., Pearson, 2013.
2. Mitra S. K., *Digital Signal Processing: a Computer based Approach*, 3rd ed., Tata McGraw-Hill, 2012.

Reference Books:
1. Proakis, J.G. and Manolakis, D.G., *Digital Signal Processing: Principles, Algorithms and Applications*, 4th ed., Pearson, 2011.
2. Chen, C-T, *Digital Signal Processing: Spectral Computation and Filter Design*, Oxford University Press, 2001
3. Salivahanan, S. and Gnanapriya, C., *Digital Signal Processing*, 2nd ed., Tata McGraw Hill, 2011.

Course Code: ECL353
Course Title: Microcontroller and Interfacing
Structure (L-T-P): 3-0-0
Prerequisite: ECL256
Contents:
Von Neumann and Harvard architecture.
8085 Microprocessor: architecture, Addressing Modes Instruction set, instruction types and formats; Instruction execution, instruction cycles, different types of machine cycles and timing diagram. Interrupts, Priority Interrupt controller 8259, Interfacing with 8255, RAM, ROM, keyboard. 8086 architecture and programming. Introduction to evolution of Microprocessor architecture.
Microprocessor v/s Microcontroller

8051 Microcontroller: architecture, Addressing Modes, Instruction set and timing diagrams. Assembly language programming of 8051. Lab experiments will be based on 8085 and C51 architecture.

Text Books:

1. Gaonkar, R. *Microprocessor Architecture, Programming and Applications with the 8085*. 5th ed., Penram International Publishing, 2011.
2. Mazidi, M.A. *The 8051 Microcontroller And Embedded Systems Using Assembly And C*. 2nd ed., Pearson Education, 2013.

Reference Books:

1. Predko, M. *Programming and Customizing the 8051 Microcontroller*. McGraw Hill, 1999.
2. Hall, D.V. Microprocessors & Interfacing. 3rd ed. Tata McGraw-Hill, 2012.

Course Code: ECL354
Course Title: Antenna Theory
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Fundamental Concepts: Physical concept of radiation, retarded potentials, Hertzian dipole; Antenna parameters: Radiation pattern, gain, directivity, effective aperture, and reciprocity; Radiation from dipoles of arbitrary length.

Antenna Arrays: Arrays of point sources, End-fire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays.

Broadband Antennas: Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.

Aperture and Reflector Antennas: Huygens' principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas.

Printed Antennas: Radiation from rectangular and circular patches, feeding techniques.

Introduction to recent trends: Leaky wave antenna, SIW structures, Vivaldi Antenna, Optical antennas, Fractal Antennas, reconfigurable antennas.

Text Books:

1. Balanis, C.A., *Antenna Theory and Design*, 3rd Ed., John Wiley & Sons. 2005
2. Kraus, J.D. and Fleisch, D.A., *Electromagnetics with Applications*, McGraw-Hill. 1999.
3. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*, 2nd Ed., Prentice-Hall of India. 1993.

Reference Books:

1. Stutzman, W.L. and Thiele, H.A., *Antenna Theory and Design*, 2nd Ed., John Wiley & Sons. 1998
2. Elliot, R.S., *Antenna Theory and Design*, Revised edition, Wiley IEEE Press. 2003
3. Garg, R., Bhartia, P., Bahl, I. and Ittipiboon, A., *Microstrip Antenna Design Handbook*, Artech House. 2001

Course Code: ECL355
Course Title: Digital Communication Systems
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Comparison of analog and digital communication. Advantages and disadvantages of digital communication. Source Coding of Analog Sources: PCM-TDM, Delta modulation, Adaptive DM, DPCM, ADPCM. Source coding of digital sources: Information, entropy, Shannon's source coding theorem, Huffman algorithm, prefix codes .General digital transmitter and receiver, signal constellation and geometric interpretation of signals, performance of matched filter receiver and correlator receiver in the presence of white noise. Threshold setting and error probability. Baseband transmission: Line coding fundamentals, transmission formats, spectral requirements, error probabilities, types of noise and other impairments. Inter-symbol interference, Nyquist's results for ISI, Eye pattern and adaptive equalization. Pass-band transmission methods: Binary ASK, PSK and FSK, Quadrature multiplexing, QPSK and QAM methods, MSK and GMSK. Basic detection algorithms, error probability and spectral requirements. Constellations and their applications in study of communication channels. Error control coding: Shannon's channel capacity theorem, significance of the theorem. Linear block codes generation and decoding, hamming distance considerations, cyclic codes and their applications, convolutional codes and viterbi decoding algorithm.

Basics of TDMA, FDMA, OFDM.

Lab experiments based on subject.

Text Books:

1. Haykin, S.S. and Moher, M., *Communication Systems, 5th ed.,* John Wiley and Sons, 2012.
2. Lathi, B.P. and Ding, Z., *Modern Digital and Analog Communication Systems*, 4th ed., Oxford University Press, 2012.

Reference Books:

1. Proakis, J.G. and Salehi, M., *Digital Communications, 5th ed*., McGraw Hill, 2010.
2. Taub, H., Schilling, D.L. and Saha, G., *Principles of Communication Systems*, 2nd edition, Tata McGraw-Hill, 2008.

Course Code: ECL356
Course Title: Microwave Theory and Techniques
Structure (L-T-P): 3-0-0
Prerequisite: ECL254
Contents:

Transmission line theory: Lumped element circuit model, field analysis, terminated lossless transmission line, smith chart, quarter wave transformer, generator and load mismatches, lossy transmission lines, transient analysis.

General solutions for TEM, TE and TM waves, parallel plate waveguide, rectangular waveguide, circular wave guide, coaxial line, surface waves on a ground dielectric sheet, stripline, microstripline, transverse resonant techniques, wave velocities and dispersion.

Microwave Network analysis: Equivalent voltages and currents, Impedance and Admittance matrices, scattering matrix, ABCD matrix, signal flow graphs, Excitation of waveguides.

Matching with lumped elements, single stub matching, quarter wave transformer, theory of small reflections.

Microwave resonators: series parallel resonator circuits, transmission line resonators, rectangular and circular cavity resonators, excitation of resonators, cavity perturbations.

Properties of power dividers and couplers, The T junction power divider, the Wilkinson power divider, wave guide directional couplers, the quadrature hybrid, coupled line directional couplers, lange coupler, 180 degree hybrid.

Text Books:

1. Pozar, D.M. *Microwave and RF Design of Wireless Systems*. Wiley, 2000.
2. Shevgaonkar, R.K., *Electromagnetic Waves,* 6th ed., Tata McGraw-Hill, 2011.

Reference Books:

1. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*, 2nd ed., Prentice Hall of India, 2013.
2. Collin, R.E. *Foundation of Microwave Engineering*. 2nd ed. Wiley India, 2012.

Course Code: ECL357
Course Title: Information Theory and Coding
Structure (L-T-P): 3-0-0
Prerequisite: SCL253
Contents:

Information Theory: Introduction- Information Measures, Entropy, Relative Entropy, Mutual Information, Information inequalities. Source Coding and Data compression- Asymptotic Equipartition Property (AEP), Variable length coding, Kraft-McMillan Inequality, Huffman Coding, Optimality of Huffman codes, Shannon-Fano-Elias coding and Arithmetic coding. Channel Capacity and Differential Entropy- Channel capacity and its properties, examples, jointly typical sequences, Channel coding theorem, AEP for continuous random variables, differential entropy and its properties, Gaussian (AWGN) channel and capacity of AWGN channel.

Coding Theory: Linear block codes - Generator and Parity check matrices, Error detection, Error correction, Hamming codes. Cyclic codes- Encoding and decoding of cyclic codes, Reed Solomon codes. Convolutional codes- Encoding, Distance properties, Viterbi decoding, BCJR decoding. Turbo coding- Encoding, iterative decoding of turbo codes, Performance analysis. Low density Parity Check codes- Encoding and decoding, Belief propagation algorithm.

Text Books:

1. T.M. Cover, T.M. and J.A Thomas, *Elements of Information Theory*, 2nd Edition, John Wiley & Sons, 2006.
2. Shu Lin and Daniel J. Costello, Jr. *Error Control Coding*, 2nd Edition, Prentice Hall, 2004.

Reference Books:

1. Robert G. Gallager, *Information Theory and Reliable Communications*, John Wiley and Sons, 1968.
2. R. B. Ash, *Information Theory*, Dover, 1990.
3. Todd K. Moon, *Error Correction Coding*, 1st Edition, Wiley-Interscience, 2006.
4. Shu Lin and William E. Ryan, *Channel Codes: Classical and Modern*, 1st Edition Cambridge University Press, 2009.

Course Code: ECL461
Course Title: Wireless Communications
Structure (L-T-P): 3-0-0
Prerequisite: ECL355
Contents:

Cellular engineering concepts; frequency reuse, frequency management and channel assignment, handoff and handoff strategies, trunking theory, coverage and capacity improvements, medium access techniques, FDMA, TDMA, CDMA, SDMA.

Wireless Mobile Communication channel characterization: large scale path loss, free space propagation model, propagation effects such as reflection, diffraction, scattering etc. Outdoor and indoor propagation models, ray tracing and coverage prediction. Small scale fading effects: time-variant impulse response model, channel correlation functions and spectral densities, coherence time, coherence bandwidth, channel models for Rayleigh, Ricean and Nakagami fading.

Spread Spectrum methods: basics; generation and properties of PN sequences, DS-SS system analysis; slow and fast FH-SS system; performance analysis.

Interference measurement and reduction, co-channel and other interference, Diversity methods for Mobile Wireless Radio Systems, concepts of diversity branch and signal paths, combining and switching methods, C/N and C/I ratio improvements, average error probability improvements.

Review, and discussion on fundamental design issues of 2/3G systems:

GSM, GPRS, CDMA2000, UMTS, LTE

IEEE 802.11 Wireless LAN's system and protocol architecture, physical layer and MAC, options like 802.11b, a g etc. and their purpose. Bluetooth: User scenarios, layered architecture, link management, L2CAP, SDP, IEEE 802.15

Text Books:

1. Rappaport, T.S., *Wireless Communication: Principles and Practices*, 2nd ed., Pearson Education, 2013.

Reference Books:

1. Feher, K., *Wireless Digital Communication*, Prentice Hall of India, 2011.
2. Proakis, J.G. and Salehi, M., *Digital Communications*, 5th ed., McGraw Hill, 2010.
3. Haykin, S., *Digital Communication*, Wiley India, 2012.
4. Haykin, S., *Communication Systems*, 5th ed., Wiley India, 2013. Schiller, J., *Mobile Communication*, 2nd ed., Pearson Education, 2012

Course Code: ECL462
Course Title: Electronic System Design
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Design of Power supply system: Unregulated D.C.. power supply system with rectifiers and filters. Design of emitter follower regulator, series regulators, overload protection circuits for regulators. Design of SMPS: Step up and step down.

Design of class A small signal amplifiers: Emitter follower, Darlington pair amplifiers with and without Bootstrapping, Two stage direct coupled amplifier. Design of class A, Class AB audio power amplifier with drivers.

Design of sinusoidal oscillators: OPAMP based Wein bridge and Phase Shift oscillators with AGC circuits, Transistor based Hartley, Colpits and Crystal oscillators, Evaluation of figure of merit for all above oscillator circuits.

Design of constant current sources, Design of function generators, Design of tuned amplifiers. Design of Butterworth, Chebyshev filters upto sixth order with VCVS and IGMF configuration.

Text Books:

1. Regulated Power supply Handbook. Texas Instruments.
2. Electronics : BJT's, FETS and Microcircuits – Anielo.
3. Monograph on Electronic circuit Design : Goyal & Khetan.

Course Code: ECL463
Course Title: Optical Communication Systems
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Optical Fibers: Structure, Waveguiding. Step-index and graded index optical fibers. Modal analysis. Classification of modes. Single Mode Fibers. Pulse dispersion. Material and waveguide dispersion. Polarization Mode Dispersion. Absorption, scattering and bending losses. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

Optical Power Launching and Coupling: Lensing schemes for coupling improvement. Fiber-to-fiber joints. Splicing Techniques. Optical fiber connectors.
Optical sources and detectors: Laser fundamentals. Semiconductor Laser basics. LEDs. PIN and Avalanche photodiodes.
Design considerations of fiber optic systems: Analog and digital modulation. Noise in detection process. Bit error rate. Optical receiver operation.
Power Budget and Rise time Budget. WDM. GPON, FTTH

Text Books:

1. Senior, John M. *Optical Fiber Communication*. 3rd ed. Pearson Education 2009.

Reference Books:

1. Keiser, G. *Optical Fiber Communications* .4th ed. TMH, 2013.
2. Agrawal, G. P. *Fiber Optic Communication Systems*.4th ed. Wiley, 2010
3. Ramaswami R., Sivarajan K. N. *Optical Networks*. 3rd ed. Elsevier, 2010.
4. Fiber Optic Communications, Harold B Killen, Prentice hall, 1991.
5. Fiber Optics Communications, Harold B Kolimbiris, United states Edition , Pearson Educational International.

Course Code: ECL464
Course Title: Radar Systems
Structure (L-T-P): 3-0-0
Prerequisite: ECL253
Contents:

Principles of communication, Introduction to radar systems. Basic radar functions, classifications.
Free space radar range equation, maximum unambiguous range, Pulse radar System, Radar Receivers- General Principles/salient features. Radar Displays: A-scope, B-scope, E-scope, F-scope and pulse position indicator. Resolution, spatial frequency, Fourier transforms, sampling theorem and spectrum replication, Signal conditioning and Interference Suppression, Imaging.Target Detection, Scanning and tracking with radars, Doppler Effect, CW Doppler radar, Moving Target Indicator, blind Speeds, Frequency Modulation CW Radar,
Signal Models: Amplitude Model, Frequency Model, Clutter, noise model and SNR, Jamming.

Text Books:

1. Skolnik, Merrill I. *Introduction to Radar Systems*. Tata McGraw-Hill Education; 2007.

Reference Books:

1. Raemer, Harold R. *Radar Systems Principles*. CRC Press, 1996.
2. Lynn, Paul A. *Radar Systems. Springer Science & Business Media*.

Course Code: ECL465
Course Title: Satellite Communication Systems
Structure (L-T-P): 3-0-0
Prerequisite: ECL253
Contents:

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems.
Satellite Orbits: Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.
Satellite Construction (Space Segment): Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.
Satellite Links: Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.
Earth Station: Introduction, earth station subsystem, different types of earth stations.
Satellite system: GPS, remote sensing etc.

Text Books:

1. Roddy, D. *Satellite Communications*. 3rd ed. McGraw-Hill International, 2001.

Reference Books:

1. Pritchard, W. L., Sciulli, J. A. *Satellite Communication Systems Engineering*. 2nd ed, Prentice-Hall, Inc., 1993
2. Kolawole, M. O. *Satellite Communication Engineering.* Marcel Dekker*,* Inc., 2002.
3. Pratt, T., Charles, W. B. *Satellite Communications*. 2nd ed. John Wiley & Sons, 2002.

Course Code: ECL466
Course Title: Finite Automata
Structure (L-T-P): 3-0-0
Prerequisite: ECL256
Contents:

Brief review of combinational and sequential circuit design and optimization, functional decomposition and symmetric functions, identification of symmetric functions. Threshold logic, synthesis of threshold networks. Fault detection in combinational circuits, Boolean differences and Path sensitization. Synchronous sequential circuits and iterative networks, memory elements and their excitation functions, synthesis of synchronous sequential circuits, Moore and Mealy machines, Applications to controller design, finite state machine flow charts, tables, ASM charts. Machine minimization, Asynchronous Sequential circuits, synthesis, state assignment, minimization.

Text Books:

1. Kohavi, Z. and Jha, N. K. *Switching and Finite Automata Theory*, 3rd ed. Cambridge University Press, 2013.

Reference Books:

1. Kohavi, Z. Switching and Finite Automata Theory, 2nd ed. Tata McGraw Hill, 1978.
2. Taub, H. *Digital Circuits and Microprocessors*. McGraw Hill, 1986.
3. Mano, M.M. *Digital Logic and Computer Design*. Pearson, 2011.
4. Lee, S.C. *Modern Switching Theory and Digital Design*. Prentice-Hall, 1978.

Course Code: ECL467
Course Title: Radio Frequency and Microwave Engineering
Structure (L-T-P): 3-0-0
Prerequisite: ECL254
Contents:

Two port RF networks-circuit representation, Reciprocal and lossless networks, transmission matrix, Introduction to component basics, wire, resistor, capacitor and inductor.
Scattering matrix-Concept of N port scattering matrix representation. Microwave junctions, Tee junctions, Magic Tee, Rat race, Corners, bends and twists, Directional couplers, two hole directional coupler, Ferrites microwave properties and applications, Termination,

Gyrator, Isolator, Circulator, Attenuator, Phase changer, S Matrix for microwave components, Cylindrical cavity resonators.

Microwave semiconductor devices, operation, characteristics and application of BJTs and FETs -Principles of tunnel diodes-Varactor, Step recovery diodes, Gunn diode-Avalanche Transit time devices-IMPATT and TRAPATT devices. Parametric devices-Principles of operation- applications of parametric amplifier. Microwave monolithic integrated circuit (MMIC) - Materials and fabrication techniques

Microwave tubes and measurements, Microwave tubes- High frequency limitations - Principle of operation of Multi cavity Klystron, Reflex Klystron, Traveling Wave Tube, and Magnetron. Measurement of power, wavelength, impedance, SWR, attenuation, Q and Phase shift.

Text Books:

1. Liao, S.Y. *Microwave Devices and Circuit*. 3rd ed. Pearson Education, 2012.
2. Ludwig, R., and Bogdanov, G. *RF Circuit Design: Theory and Applications*. 2nd ed. Pearson Education, 2013.

Reference Books:

1. Collin, R.E. *Foundation of Microwave Engineering*. 2nd ed. Wiley India, 2012.
2. Das, A. and Das, S.K. *Microwave Engineering*. 2nd ed Tata McGraw Hill, 2012.

Course Code: ECL468
Course Title: Embedded System Design
Structure (L-T-P): 3-0-0
Prerequisite: ECL256, ECL353
Contents:

Microcontroller and Embedded Processors, Overview of 8051 Microcontroller family: Architecture, basic assembly language programming concepts, The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks and Stack Instruction set, Loop and jump instructions, Call Instructions, Time delay generations and calculations, I/O port programming Addressing Modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, BCD and ASCII application programs, Single-bit instruction programming, Reading input pins vs. port Latch, Programming of 8051 Timers, Counter Programming. Communication with 8051: Basics of communication, Overview of RS-232, I^2C Bus, UART, USB, 8051 connections to RS-232, 8051 serial communication programming, 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, interrupt priority in the 8051

Interfacing with 8051: Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor, 8051 interfacing to the keyboard, Interfacing a DAC to the 8051, 8255 Interfacing with 8031/51, 8051/31 interfacing to external memory

Text Books:

1. Raj Kamal, "Embedded Systems", TMH, 2004.
2. M.A. Mazidi and J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", PHI, 2004.

Reference Books:

1. David E.Simon, "An Embedded Software Primer", Pearson Education, 1999.
2. K.J. Ayala, "The 8051 Microcontroller", Penram International, 1991.
3. Dr. Rajiv Kapadia, "8051 Microcontroller & Embedded Systems", Jaico Press
4. Dr. Prasad, "Embedded Real Time System"

Course Code: ECL469
Course Title: Hardware Description Language
Structure (L-T-P): 3-0-0
Prerequisite: ECL256
Contents:

Modeling digital systems, Hardware design environment, Design Flow, Hard ware description languages, Various design styles. Introduction to Verilog, elements of Verilog, basic concepts in Verilog, simulation, synthesis. Dataflow modeling, Concurrent signal assignment, delays, Behavioral modeling, processes. Design organization, Structural specification of hardware, parameterization, hierarchy, abstraction, configurations, utilities. Subprogram, packages, libraries, Basic I/O, Programming mechanics Synthesis, RTL description, constraints attributes, FPGA, CPLD structure, technology libraries. Introduction to VHDL Programming

Text Books:

1. Palnitkar, S. *Verilog HDL: A guide to Digital Design and Synthesis*. 2nd ed. Pearson, 2013.

Reference Books:

1. Bhasker, J. *A System Verilog Primer*. 1st Indian ed. B.S. Publication, 2013.
2. Navabi, Z. *VHDL: Analysis and Modeling of Digital Systems*. 2nd ed. McGraw Hill, 2000.
3. Weste, N.H.E., Harris, D., and Banerjee, *A.CMOS VLSI Design*: *A Circuits and Systems Perspective.* 3rd ed. Pearson Education, 2012.
4. Pucknell, D.A. and Eshraghian, K. *Basic VLSI Design*. 3rd ed. PHI Learning Private Limited, 2011.
5. Brown, S.D. and Vranesic, Z.G. *Fundamentals of Digital Logic with VHDL/Verilog Design.* 3rd ed. McGraw-Hill, 2009.

Course Code: ECL502
Course Title: MOS Device Physics
Structure (L-T-P): 3-0-0
Prerequisite: Nil
Contents:

MOS Capacitor: Energy band diagram of Metal-Oxide-Semiconductor contacts, Mode of Operations: Accumulation, Depletion, Midgap, and Inversion, 1D Electrostatics of MOS, Depletion Approximation, Accurate Solution of Poisson's Equation, CV characteristics of MOS, LFCV and HFCV, Non-idealities in MOS, oxide fixed charges, interfacial charges, Midgap gate Electrode, Poly-Silicon contact, Electrostatics of non-uniform substrate doping, ultrathin gate-oxide and inversion layer quantization, quantum capacitance, MOS parameter extraction.

Physics of MOSFET: Drift-Diffusion Approach for IV, Gradual Channel Approximation, Sub-threshold current and slope, Body effect, Pao & Sah Model, Detail 2D effects in MOSFET, High field and doping dependent mobility models, High field effects and MOSFET reliability issues (SILC, TDDB, & NBTI), Leakage mechanisms in thin gate oxide, High-K-Metal Gate MOSFET devices and technology issues, Intrinsic MOSFET capacitances and resistances, Meyer model.

SOI MOSFET: FDSOI and PDSOI, 1D Electrostatics of FDSOI MOS, VT definitions, Back gate coupling and body effect parameter, IV characteristics of FDSOI-FET, FDSOI-sub-threshold slope, Floating body effect, single transistor latch, ZRAM device, Bulk and SOI FET: discussions referring to the ITRS.

Nanoscale Transistors: Diffusive, Quasi Ballistic & Ballistic Transports, Ballistic planer and nanowire-FET modeling: semi-classical and quantum treatments.

Advanced MOSFETs: Strain Engineered Channel materials, Mobility in strained materials, Electrostatics of double gate, and Fin-FET devices

Text Books:

1. Yannis Tsividis, *Operation and Modeling of the MOS Transistor*, 2nd ed., Oxford University Press, 2016.
2. Arora, N. *MOSFET Modeling for VLSI Circuit Simulation*. World Scientific, 2007.

Reference Books:

1. Yuan Taur & Tak H. Ning, *Fundamentals of Modern VLSI Devices*, Cambridge, 1998.
2. S.M. Sze & Kwok K. Ng, *Physics of Semiconductor Devices*, Wiley, 2007.
3. Mark Lundstrom & Jing Guo, *Nanoscale Transistors: Device Physics, Modeling & Simulation*, Springer, 2005.

Course Code: ECL503
Course Title: CMOS Digital VLSI Design
Structure (L-T-P): 3-0-0
Prerequisite: ECL256, ECL252
Contents:

Digital ICs design flow, Issues in Digital Integrated Circuit Design, MOS Transistor basics –Static and Dynamic Behavior, Secondary effects.

CMOS Inverter Static and Dynamic Behavior, Noise Margin, Power Consumption and Power Delay Product, Latch up, Technology Scaling.

Logic gates- Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass Transistor Logic. Dynamic CMOS Design: basic principles, performance of dynamic logic, Noise consideration, Power consumption in CMOS gates – switching activity, Glitches, Logical Efforts, Layout.

Sequential Circuits: Bistability, CMOS static flip-flop, Pseudo static latch, Dynamic two-phase flip-flop, C^2MOS latch, NORA (no race)-CMOS logic design style, Schmitt Trigger, Astable and monostable circuits.

Arithmetic Building blocks: Adder, Multiplier and Shifters, ALU Timing Issues in synchronous design Interconnect Parasitics.

Memories and array structures: ROM and RAM cells design, SRAM cell and arrays, memory peripheral circuits.

BiCMOS Logic Circuits: Introduction, Basic BiCMOS Circuit behavior, Switching delay in BiCMOS logic circuits.

Text Books:

1. Rabaey, J. M. *Digital Integrated Circuits - A Design perspective*. 2nd ed. Pearson Education, 2003.

Reference Books:

1. Martin, K. *Digital integrated circuit design*. Oxford University Press, 2000.
2. Kuo, J., and Lou, J. *Low voltage CMOS VLSI circuits*. John Wiley, 1999.
3. Weste, N., and Eshraghian, K. *Principles of CMOS VLSI Design - A Systems perspective*. 2nd ed. Addison-Wesley, 1993.

Course Code: ECL504
Course Title: CMOS Analog VLSI Design
Structure (L-T-P): 3-0-0
Prerequisite: ECL252
Contents:

Introduction: Motivation for analog VLSI and mixed signal circuits in CMOS technologies and issues thereof. CMOS device fundamentals: Basic MOS models, device capacitances, parasitic resistances, substrate models, transconductance, output resistance, fT, frequency dependence of device parameters.

Single stage amplifiers: Common source amplifier, source degeneration, source follower, common gate amplifier, cascade stage. Differential Amplifiers: Basic differential pair, common mode response, differential pair with MOS loads, Gilbert Cell, device mismatch effects, input offset voltage.

Current Mirrors, Current and Voltage Reference: Basic current mirrors, cascode current mirrors, active current mirrors, low current biasing, supply insensitive biasing, temperature insensitive biasing, impact of device mismatch.

Frequency Response of Amplifiers: Miller effect, CS amplifier, source follower, CG amplifier, cascade stage, differential amplifier, Multistage amplifier. Feedback: Feedback topologies, effect of load, modeling input and output ports in feedback circuits

Operational Amplifiers: Performance parameters, One-stage and two-stage Op Amps, gain boosting, comparison, common mode feedback, input range, slew rate, power supply rejection, noise in Op Amps Stability and Frequency Compensation: Multi pole systems, phase margin, frequency compensation

Text Books:

1. Razavi, Behzad. *Design of Analog CMOS Integrated Circuits*. 2nd ed. Tata McGraw Hill, 2002.

Reference Books:

1. Allen, Phillip E., and Holberg, Douglas R. *CMOS Analog Circuit Design*. Oxford University Press, 2002.
2. Carusone, Tony C., Johns, David A., and Martin, Kenneth W. *Analog Integrated Circuit Design*. 2nd ed. John Wiley and Sons, 1997.
3. Gray, Paul, and Meyer, Robert. *Analysis and Design of Analog Integrated Circuits*. John Wiley and Sons, 1993.
4. R. Jacob Baker. *CMOS Circuit Design, Layout, and Simulation*. 3rd ed. IEEE press Wiley, 2010.
5. Gray, P.R., Hodges, D.A., R.W. Brodersen, Eds. *Analog MOS integrated Circuits*. IEEE press Wiley, 1980.

Course Code: ECL519
Course Title: VLSI/ULSI Technology
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Environment for VLSI Technology: Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques. Impurity incorporation: Solid State diffusion modeling and technology, Ion Implantation modeling, technology and damage annealing; characterization of impurity profiles.

Wafer preparation and Crystal growth of Si and GaAs (Bridgeman, CZ and Liquid encapsulation method), Process flow of Novel MOS based devices.

Oxidation: kinetics of silicon dioxide growth both for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI. Characterization of oxide films, high k and low k dielectrics for ULSI.

Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, mask generation. Chemical Vapour Deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films. Epitaxial growth of silicon, modeling and technology.

Metal film deposition: Evaporation and sputtering techniques. Failure mechanisms in metal interconnects; Multi-level metallization

schemes Plasma and Rapid Thermal Processing: PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI. Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technologies.

Text Books:

1. Sze, S.M. *VLSI Technology*. 2nd ed. Tata McGraw-Hill, 2011.

Reference Books:

1. Ghandhi, S.K. *VLSI Fabrication Principles*. 2nd ed. Wiley India, 2010.
2. Plummer, James D. *Silicon VLSI Technology Fundamentals: Practice and Modeling*. Pearson Education, 2009.
3. Campbell, Stephen A. *The Science & Engineering of Microelectronics Fabrication*. 2nd ed. Oxford University Press, 2001.

Course Code: ECL520
Course Title: Micro Electromechanical Systems
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Introduction to MEMS, MEMs devices overview. Fabrication, Mechanical Properties.

Surface micromachining, Oxide anchored Cantilever beam, poly anchored beams, LPCVD poly silicon deposition, doping, oxidation, Transport in Poly Si, 2 and 3 terminal beams.

Bulk micromachining; Wet etching –isotropic and anisotropic; Etch stop – Electrochemical etching; Dry etching; Bonding, Comparison of bulk and Surface micromachining: LIGA; SU-8; Moulding processes; Stiction: process, in-use, Measuring stiction, Pull-in parallel plate capacitor, Pressure Sensor: piezo-resisitivity, Diffused Si, Poly, porous Si.

Beams: Structure; force, moments, equation, spring constant; Stress, pull-in, pull-out; resonance freq, etc, Accelerometer. Quasistatic, capacitive, equivalent circuit; Analog; Tunnel; Thermal accelerometer, Rate Gyroscope ,Biosensor and BioMEMS; Microfluidics; Digital Microfluidics; Ink jet printer.

Optical MEMS: Displays -DMDs, LGVs, active and passive components, RF MEMS: switches, active and passive components, Packaging; Reliability, Scaling.

Text Books:

1. Ananthasuresh, G. K. *Micro and Smart Systems*. Wiley India, 2014.

Reference Books:

1. Bao, M.-H. *Micro Mechanical Transducers: Pressure Sensors, Accelerometers and Gyroscopes*. 1st ed., Elsevier, 2004.
2. Kovacs, G.T.A. *Micromachined Transducers Source book*. Tata McGraw Hill, 1998.
3. Senturia, S.D. *Microsystem Design*. Kluwer Academic Publishers, 2005.

Course Code: ECL521
Course Title: Internet of Thing
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Introduction: Overview of IoT systems, Components of an IoT system, Sensor Node: Wearable Electronics Sensors, Calibration, Batteries, Power supply, Microprocessors, Data communication Sensor Node: Firmware design, Basic firmware design concepts – Digital arithmetic, Data format, H/w resources utilization, Power optimization, Modularization, Data/command interfaces, Clock budgeting.

Connectivity API development using Python and Android, Networking, IoT Data Processing, IoT data management, Python libraries for data analysis (Pandas, scikit), Cloud computing

Text Books:

1. Arshdeep Bahga and Vijay Madisetti. *Internet of Things: A Hands-on Approach*, Universities Press, 2015.

Reference Books:

1. Edward Ashford Lee and Sanjit Arun kumar Seshia. *Introduction to Embedded Systems: A Cyber-Physical Systems Approach*, 2013.
2. John Guttag. *Introduction to Computation and Programming using Python*, MIT Press, 2013.

Course Code: ECL542
Course Title: Image Processing
Structure (L-T-P): 3-0-0
Prerequisite: ECL352
Contents:

Image representation, gray scale and colour images, image sampling and quantization. Two dimensional orthogonal transforms-DFT, FFT, WHT, Haar trans-form, KLT, DCT. Image enhancement-filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection-non parametric and model based approaches, LOG filters, localisation problem. Image Restoration-PSF, circulant and block circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods. Mathematical morphology, binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition. Computer tomography parallel beam projection, Radon transform, and its inverse, Back-projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection. Image communication, JPEG, MPEGs and H.26x standards, packet video, error concealment.

Image texture analysis, co-occurrence matrix, measures of textures, statistical models for textures. Hough Transform, boundary detection, chain coding, and segmentation, thresholding methods.

Text Books:

1. Jain, A. K., *Fundamentals of Digital Image Processing*, Prentice Hall of India, 2012.
2. Gonzalez, R.C. and Woods, R.E., *Digital Image Processing*, 3rd ed., Pearson Education, 2013.

Reference Books:

1. Haralick, R.M. and Shapiro, L.G., *Computer and Robot Vision*, Addison Wesley, 1993.
2. Jain, R., Kasturi, R. and Schunck, B.G., *Machine Vision*, McGraw-Hill, 1995.
3. Pratt, W. K., Digital Image Processing, 4th ed., Wiley India, 2012.

Course Code: ECL545
Course Title: Human and Machine Speech Communications
Structure (L-T-P):3-0-0
Prerequisite: ECL251
Contents:

Introduction: Human-machine speech communications aspects; digital representations of speech; intensity level of sound.

Speech production: Anatomy and physiology of speech organs; articulatory phonetics; acoustic phonetics; phonetics transcription, Physiological and Mathematical Model.

Speech signal analysis: Time domain methods; Frequency domain methods; Pitch estimation spectrogram analysis; Spectrum analysis, MFCC.

Linear prediction coding: Least squares autocorrelation and covariance methods; Line spectral frequencies.

Psychoacoustics and auditory perception: Hearing; critical bands; phenomena of masking; Mel scale.

Speech signal coding: Speech coder attributes; Coding rates; PCM; ADPCM; CELP; Coding standards.

Assessment of speech quality: Objective and subjective quality evaluation measures.

Automatic Speech recognition: Pattern recognition approach; Dynamic time warping; Feature extraction; HMM; Language models.

Text Books:

1. Rabiner, L. R., and Schafer, R. W. *Digital Processing of Speech Signals*. 4th ed. Pearson Education, 2009.

Reference Books:

1. Quatieri, Thomas F., Cloth. *Discrete-Time Speech Signal Processing: Principles and Practice.* Pearson Education, 2008.
2. Young, S., and Bloothooft, G. *Corpus-Based Methods in Language and Speech Processing*. Springer Science and Business Media, 2013.
3. Deller, J, R., Proakis, J. G., and Hansen J. H. *Discrete Time Processing of Speech Signals*. John Wiley and Sons, 2000
4. Gold, B., and Morgan, N. *Speech and Audio Signal Processing: Processing and perception of speech and music*. 2nd ed. John Wiley and sons 2011.
5. Huang, X. D., Ariki, Y., and Jack, M. A. *Hidden Markov Models for Speech Recognition*. Edinburgh University Press, 1990.

Course Code: ECL551
Course Title: Adaptive Signal Processing
Structure (L-T-P): 3-0-0
Prerequisite: ECL352
Contents:

Vectors, Matrices and Eigen Analysis. Application to adaptive signal processing. Stochastic Processes, Ensemble average, mean, average power, auto and cross correlation functions, stationarity and white noise, Auto-regressive process. Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued signals.

Least Squares and LMS algorithms, Normal equations, properties. Eigen System decomposition. Gradient search technique, convergence properties of LMS. Normalized LMS algorithm. Recursive solution techniques, RLS algorithm. Application to noise cancellation, modeling of physical processes, communications.

Text Books:

1. Haykin, S., *Adaptive Filter Theory*, 4th ed., Pearson Education, 2012.

Reference Books:

1. Treichler, J.R., *Theory and Design of Adaptive Filters*, Prentice Hall of India, 2010.
2. Widrow B., Stearns S.D., *Adaptive Signal processing*, Prentice Hall, 1985.

Course Code: ECL552
Course Title: Introduction to Machine Learning
Structure (L-T-P): 3-0-0
Prerequisite: SCL253
Contents:

Introduction: Basic definitions, types of learning, Clustering vs. Classification; Supervised vs. unsupervised, Relevant basics of Linear Algebra, vector spaces, hypothesis space and inductive bias, evaluation, cross-validation.

Linear regression, Decision trees, Over fitting.

Instance based learning, Feature reduction, Collaborative filtering based recommendation.

Probability and Bayes learning.

Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Neural network: Perceptron, Multilayer network, Back propagation, Introduction to Deep Neural Network.

Clustering: introduction, k-means, Gaussian Mixture Model.

Text Books:

1. Tom Mitchell *Machine Learning*, 1st Ed., McGraw- Hill, 1997.
2. Ethem Alpaydin, *Introduction to Machine Learning*, 2nd ed.
3. R. O. Duda, P. E. Hart and D. G. Stork, *Pattern Classification*, 2nd edition, Wiley-Interscience, 2001.

Reference Books:

1. Bishop, Christopher M., *Pattern Recognition and Machine Learning*, Springer, 2007.
2. Koller, D., and Friedman, N. *Probabilistic Graphical Models: Principles and Techniques*. MIT Press, 2009.
3. Theodoridis, S. and Konstantinos Koutroumbas, *Pattern recognition*, 4th Ed., Academic Press, 2008.

Course Code: ECL562
Course Title: Principles of Biomedical Instrumentation Design
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Introduction and basic concepts of biomedical instrumentation-Classification of Biomedical Instruments-Compensation Techniques-Generalized static and dynamic characteristics-Design Criteria- Basic Sensors and Principles

Measurement characteristics-Review of Circuit Analysis-Amplifiers and Signal Processing-Inverting, Non-inverting, Differential and logarithmic amplifiers-Integrators-Differentiators-Microcomputers in Medical Instrumentation

The origin of Biopotentials-Biopotential electrodes-Biopotential Amplifiers-Blood Pressure and Heart Sounds measurement-Measurement of Blood flow and Volume-Measurement of Respiratory System

Chemical Biosensors-Clinical Laboratory Instrumentation-Medical Imaging Systems-Therapeutic and Prosthetic Devices

Electrical Safety-Physiological effects of electricity-Macroshock and Microshock hazards-Electrical Distribution and Ground Faults-Basic protection techniques against shock and equipment damage

Recent trends in Biomedical Instrumentation

Text Books:

1. Webster, J.G., Medical Instrumentation: Application and Design, 4th ed., John Wiley and Sons, 2010.
2. Cromwell, L., Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurements, 2nd ed., Prentice Hall of India, 2013.

Reference Books:

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, 2nd ed., Tata McGraw Hill,2012.
2. Singh, M., Introduction to Biomedical Instrumentation, PHI Learning Private Limited, 2010.
3. Ganong, W.F. et. al., Review of Medical Physiology, 24th ed., McGraw Hill, 2012.
4. Cook, A.M. and Webster, J.G., Therapeutic Medical Devices, Application and Design, Prentice-Hall, 1982.

B.Tech. (Mechanical Engineering)
OVERALL CREDIT STRUCTURE

Undergraduate Core(UC)		Undergraduate Elective (UE)	
Category	*Credit*	*Category*	*Credit*
DC	67	**DE**	23 (minimum)
BS	19	**HM**	06 (minimum)
ES	22	**OC**	18 (Balance)
HM	05	**UN**	0 (03 Courses)
Total	113	**Total**	47
Grand Total (UC + UE)			**160**

Basic Science (BS)			
Course Code	**Course**	**L-T-P**	**Credit**
SCL152	Applied Mathematics-I	3-2-0	04
SCL153	Applied Mathematics-II	3-2-0	04
SCL251	Applied Mathematics-III*	3-0-0	03
SCL154	Applied Physics	3-0-0	03
SCP154	Applied Physics Lab	0-0-2	01
SCL155	Applied Chemistry	3-0-0	03
SCP155	Applied Chemistry Lab	0-0-2	01
Total			**19**

Humanities and Management (Core) (HM)			
Course Code	**Course**	**L-T-P**	**Credit**
HMP152	Technical Communication	2-0-2	03
HML151	Social Science	2-0-0	02
Total			**05**

Engineering Arts and Science (ES)			
Course Code	**Course**	**L-T-P**	**Credit**
MEL152	Elementary Mechanical Engineering	3-0-0	03
EEL151	Elementary Electrical Engineering	3-0-0	03
EEP151	Elementary Electrical Engineering Lab	0-0-2	01
ECL151	Basic Electronics Engineering	3-0-0	03
ECP151	Basic Electronics Engineering Lab	0-0-2	01
MEL151	Engineering Drawing	3-0-0	03
MEP151	Engineering Drawing Lab	0-0-2	01
CSL151	Computer Programming and Problem Solving	3-0-0	03
CSP151	Computer Programming Lab	0-0-2	01
MEP152	Mechanical Workshop	0-0-2	01
CEL151	Environmental Science	2-0-0	02
Total			**22**

Non Credit Requirement (UN)			
Course Code	**Course**	**L-T-P**	**Credit**
NCN101	NCC#	-	0
NCN102	NSS#	-	0
NCN103	NSO#	-	0
SPB101	Sports-I#	0-0-4	0
SPB102	Sports-II#	0-0-4	0
HMD251	Community Project	-	0
MET251	Practical Training	-	0

#A student has to opt at least one from NCC, NSS, NSO and Sports (I & II both).

Departmental Core (DC)			
Course Code	**Course**	**L-T-P**	**Credit**
MEL251	Mechanical Behaviour of Materials	3-0-0	03
MEL252	Engineering Thermodynamics	3-0-0	03
MEL253	Fluid Mechanics	3-0-0	03
MEP253	Fluid Mechanics Lab	0-0-2	01
MEL254	Solid Mechanics	3-0-0	03
MEP254	Solid Mechanics Lab	0-0-2	01
MEL255	Kinematics of Machines	3-2-0	04
MEL256	Machine Drawing	1-0-0	01
MEP256	Machine Drawing Lab	0-0-4	02
MEL257	Casting Welding and Forming	3-0-0	03
MEP257	Casting Welding and Forming Lab	0-0-2	01
MEL258	Machining and Machine Tools	3-0-0	03
MEP258	Machining and Machine Tools Lab	0-0-2	01
MEL351	Energy Conversion Techniques	3-0-0	03
MEP351	Energy Conversion Techniques Lab	0-0-2	01
MEL352	Fluid Machines	3-0-0	03
MEP352	Fluid Machines Lab	0-0-2	01
MEL353	Heat and Mass Transfer	3-0-0	03
MEP353	Heat and Mass Transfer Lab	0-0-2	01
MEL354	Dynamics of Machines	3-0-0	03
MEP354	Dynamics of Machines Lab	0-0-2	01
MEL355	Measurement and Control	3-0-0	03
MEP355	Measurement and Control Lab	0-0-2	01
MEL356	Operations Management	3-0-0	03
MEL357	Design of Machine Elements	3-2-0	04
MEL451	Refrigeration & Air Conditioning	3-0-0	03
MEP451	Refrigeration & Air Conditioning Lab	0-0-2	01
MEL452	Mechanical Vibrations	3-0-0	03
MEP452	Mechanical Vibrations Lab	0-0-2	01
MED351	Minor Project	-	01
MED451	Major Project	-	02

Departmental Elective (DE)			
Course Code	**Course**	**L-T-P**	**Credit**
SCL453	Probability Theory and Statistics	3-0-0	03
MEL358	Metrology and SQC	3-0-0	03
MEP358	Metrology and SQC Lab	0-0-2	01
MEL453	Operation Research	3-2-0	04
MEL454	Industrial Engineering	3-0-0	03
MEL455	Fluid Dynamics	3-0-0	03
MEL456	Computer Aided Design	3-0-0	03
MEP456	Computer Aided Design Lab	0-0-2	01
MEL457	Computer Integrated Manufacturing	3-0-0	03
MEL458	Mechatronics	3-0-0	03
MEP458	Mechatronics Lab	0-0-2	01
MEL459	Gas Turbine and Compressor	3-0-0	03
MEL460	Quality Assurance	3-0-0	03
MEL461	Robotics	3-0-0	03
MEP461	Robotics Lab	0-0-2	01
MEL462	Automation in Production	3-0-0	03
MEL463	Power Plant Engineering	3-0-0	03
MEL464	Renewable Energy Sources	3-0-0	03
MEL465	Automobile Engineering	3-0-0	03
MEP465	Automobile Engineering Lab	0-0-2	01
MEL466	IC Engine	3-0-0	03
MEP466	IC Engine Lab	0-0-2	01
MEL467	Tool Design	3-2-0	04
MEL468	Machine Tool Design	3-2-0	04
MEL469	Material Resource Planning	3-0-0	03
MEL470	Computer Integrated Manufacturing	3-0-0	03
MEP471	Machine System Design Lab	0-0-4	02

Course Syllabi (Under Graduate)
Department of Mechanical Engineering

Course Code: MEL 151
Course Title: ENGINEERING DRAWING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Scales-concept of representative fraction, importance of scales, Orhographic projections, Projections of points, Projections of Straight lines and practical applications, Projections of planes, Projections of solids (right and regular prisms, pyramids, cones and cylinders), Auxiliary Views of Planes and Solids, Sections of solids, Development of surfaces of solids, Isometric projections. Introduction to AutoCAD.

Text Book:
1. Bhatt, N.D, Engineering Drawing: Plane and Solid Geometry, 51st ed., Charotar Publishing House Pvt. Ltd., 2012.

Reference Books:
1. Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production, 11th ed., Prentice Hall, 2012.
2. Gill, P.S., A Text Book of Engineering Drawing: Geometrical Drawing, 11th ed., S.K. Kataria& Sons, 2009.
3. Agrawal, B. and Agrawal, C.M., Engineering Drawing, 7th ed., Tata McGraw Hill Education, 2011.
4. Shah, M.B. and Rana, B.C., Engineering Drawing, 2nd ed., Pearson Education, 2012.
5. Jolhe, D.A., Engineering Drawing: With an Introduction to AutoCAD, Tata McGraw Hill Education, 2011.

Course Code: MEL 152
Course Title: ELEMENTARY MECHANICAL ENGINEERING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Mechanics Introduction: System of forces, coplanar concurrent force system, equilibrium of rigid bodies, free body diagram, Lami's theorem, varignon's theorem, Analysis of framed structure: Reaction in beam with different end conditions, determination of reactions in members of trusses. Centre of gravity and moment of inertia: Concept of C.G and centroid, position of centroid, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures. Types of Friction, Introduction to stress and strain, Elastic constants.

Basics of Thermal and Fluid Science: Introduction, thermodynamics properties, forms of energy, thermodynamic systems and control volume, steady flow systems, types of work, thermodynamic processes, Zeroth, first and second law of thermodynamics, Reversible and Irreversible processes, steady-state energy equation and its applications, Heat engine, Heat pump and refrigerator, COP.

Introduction to IC Engine: two-stroke engine, four stroke engine, Otto Cycle, Diesel Cycle and dual cycle.Introduction to fluid mechanics, Properties of fluids, surface tension, compressibility, pressure measurement.

Text Book:
1. Beer and Johnston, Vector Mechanics for Engineers: Statics and Dynamics, 10th ed., Tata McGraw-Hill, 2013.
2. Cengel Y. A., Boles M., Thermodynamics: An Engineering Approach, 8th ed. McGraw- Hill, 2006.

Reference Book:
1. Shames, I.H., Engineering Mechanics: Statics and Dynamics, 4th ed., Pearson Education, 2011.
2. Nag P. K., Engineering Thermodynamics, 5th ed., Tata McGraw- Hill, 2005.
3. Cengel Y. A., Cimbala, J. M., Fluid Mechanics: Fundamentals and Applications, 3rd ed., Tata McGraw- Hill, 2010.

Course Code: MEL 251
Course Title: MECHANICAL BEHAVIOUR OF MATERIALS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Structures of materials – crystal structure, substructure, microstructure, etc. Phase diagram and phase transformation. Diffusion phenomenon, Mechanical behavior – strength, hardness, deformation creep, fatigue, etc., Mechanisms of strengthening and toughening of materials, Metallic alloys, Ceramics, Polymeric and Composite materials, Non-destructive testing, Standard numbering system including BIS designations of materials.

Text Book:
1. Raghavan, V, Materials Science and Engineering: A First Course, 5thed., Prentice Hall, 2012.

Reference Books:
1. Avner, S.H., Introduction to Physical Metallurgy, 2nded., Tata McGraw Hill, 2012.
2. Dieter, G.E. and Bacon, D., Mechanical Metallurgy, Tata McGraw Hill, 2001.
3. Lakhtin, Y.M., Engineering Physical Metallurgy and Heat treatment, 6thed., CBS Publishers, 1998.
4. Rollason E.C., Metallurgy for Engineers, 4th ed., EdwardArnoldPublications, 1982.

Course Code: MEL252
Course Title: ENGINEERING THERMODYNAMICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents: Introduction to basic concept of thermodynamics: Types of system, state and properties of system, thermodynamic equilibrium, heat and thermodynamic work. Laws of thermodynamics. First Law of thermodynamics: Flow and non-flow system, change in internal energy, heat transferred and work transferred during various thermodynamic processes, P-V diagrams. Applications of steady and unsteady flow processes. Second law of thermodynamics: Kelvin-Plank & Clausius Statement. Heat engine, refrigerator and heat pump, reversible and irreversible processes.Carnot cycle, thermodynamic temperature scale. Entropy: Clausiusinequality, entropy principle, change in entropy for closed and open systems. Availability: Reversible work and irreversibility. Properties of Ideal gas, equation of state, internal energy and specific heats of gases.Properties of pure system and use of steam tables, Mollier charts, P-V, T-S and H-S diagrams.Dryness fraction and its measurement. Work and heat transfer during various thermodynamic processes with steam as working fluid. Air standard cycles: Otto, Diesel, Stirling, Ericsson, Atkinson and Brayton. Vapour power cycles: Simple and Modified Rankine Cycle, combined cycle.

Text Book:
1. Cengel, Y.A. and Boles M.A., Thermodynamics: An Engineering Approach, 8th ed., McGraw Hill, 2015.
2. Nag, P.K., Engineering Thermodynamics, 6th ed., Tata McGraw Hill Education, 2017.

Reference Books:
1. Moran M.J. and Shapiro H.N., Fundamentals of Engineering Thermodynamics, 6thed., Wiley- India, 2012.
2. Eastop, T.D. and McConkey, A., Applied Thermodynamics: For Engineering Technologists, 5th ed., Pearson Education, 2013.
3. Nag, P.K., Engineering Thermodynamics, 5th ed., Tata McGraw Hill Education, 2013.
4. Holman, J.P., Thermodynamics, 4th ed., Mc-Graw Hill, 1988.
5. Joel, R., Basic Engineering Thermodynamics, 5th ed., Pearson Education, 2014.
6. Arora, C.P., Thermodynamics, Tata McGraw Hill Education, 2011.

7. Borgnakke, C. and Sonntag, R.E., Fundamentals of Thermodynamics, 7th ed., Wiley India, 2011.

Course Code: **MEL253**
Course Title: **FLUID MECHANICS**
Structure (L-T-P): **3-0-0**
Pre-requisite: **NIL**
Contents: Introduction to Fluid Mechanics, fluid properties and classification. Fluid statics: Pressure variation in a static fluid, forces on submerged surfaces, stability of floating bodies, rigid body motion. Kinematics of fluid Flow, Ideal Fluid Flow.Inviscid flow: Euler equation, Bernoulli's equation and its applications, Reynolds transport theorem, mass, momentum and energy conservation laws with applications, governing equations for Newtonian fluids, exact solutionsofNavier-Stokes Equation,Internal flows: pipe flow, hydraulic diameter, laminar and turbulent flows, friction factor, Moody diagram, minor and major losses, pipe networks, flow measurement, Introduction to open channel flow.External flows: introduction to boundary layer theory, flow over flat and curved surfaces, boundary layer separation. Dimensional analysis and modeling, Buckingham Pi theorem,

Text Books:

1. White, F.M., Fluid Mechanics, 7th ed., Tata McGraw Hill Education, 2013.
2. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, 3rd ed., Tata McGraw Hill Education, 2015.

Reference Books:

1. Streeter, V.L., Wylie E.B. and Bedford, K.W., Fluid Mechanics, 9th ed., Tata McGraw Hill Education, 2011.
2. Som, S.K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd ed., Tata McGraw Hill Education, 2011.
3. Kundu, P.K., Cohen, I.M. and Dowling, D.R., Fluid Mechanics, 5th ed., Elsevier, 2012.
4. Khan, M.K., Fluid Mechanics and Machinery, 1st ed. Oxford University Press India, 2015.
5. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9th ed., Laxmi Publication, 2014.
6. Fox, R.W., Pritchard, P.J. and Mcdonald, A.T., Introduction to FluidMechanics, 7th ed., Wiley India, 2012.
7. Munson, B.R. and et al., Fundamentals of Fluid Mechanics, 6thed., Wiley India, 2012.

Course Code: **MEL254**
Course Title: **SOLID MECHANICS**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Introduction, Definition of stress, Equations of equilibrium, Principal stress, Maximum shear stress, Plane stress, Concept of strain, Strain displacement relations, Principal strains, Plane strain, Constitutive relations, Uniaxial tension test, Idealized stress-strain diagram, Isotropic linear elastic, viscoelastic and plastic materials, Uniaxial deformations, Thermal stresses, Torsion of shafts, Bending and shear of beams, Energy methods, Fracture, Deflection, Stability. Mechanical Engineering Design vis-à-vis Solid Mechanics, factor of safety, standards and design equations, Selection of materials and processes, Applicationof theories of failure to design, Design procedure and its application to static strength, Design of thin and thick pressure vessels and pipes. Design of shrink fit.

Text Books:

1. Gere, J.M. and Timoshenko, S.P., Mechanics of Materials, 3rded., CBS Publishers, 2012.
2. Beer, F.P. and Others, Mechanics of Materials, 6thed., Tata McGraw HillEducation, 2013

Reference Books:

1. Shames, I.H. and Pitarresi, J.M., Introduction to Solid Mechanics, 3rded., Prentice Hall India, 2013.
2. Popov, E.P., Engineering Mechanics of Solids, 2nded., Prentice Hall India,2012.

Course Code: **MEL255**
Course Title: **KINEMATICS OF MACHINES**
Structure (L-T-P): **3-2-0**
Prerequisite: **NIL**
Contents: Basic concept of mechanisms, links, kinematic pairs, kinematic chain, mechanisms, machine, Types of mechanisms, Degree of freedom of link and planer mechanism, Classification of four-bar chain (Class I and Class II) Inversion of four bar chain, Slider crank chain and double slider crank chain.

Velocity, acceleration analysis of planer mechanism by graphical method using relative velocity/acceleration, Instantaneous centre of velocity method, Concept of velocity and acceleration image, Coriollis component of acceleration, Synthesis of four-bar/ slider crank mechanism for gross motion, Input/Output coordination and quick return ratio, Transmission angle.

Types of cams, follower and applications, Synthesis of cam for different types of follower motion like constant velocity, parabolic SHM, cycloidal etc., Construction of eccentric cam, tangent cam and circular arc cam, Analysis of follower motion for cams with specified contours like eccentric cam, tangent cam and circular arc cam.

Introduction to Belt drive, clutches and brakes, ratio of belt tension, initial tension for flat and V belts, types of clutches and relations for torque transmitted, types of brakes and braking torque relations.

Types of gears, gear tooth terminologies, concept of conjugate action, law of conjugate action, kinematics of involute gear tooth pairs during the contact, number of pairs of teeth in contact, path of approach and path of recess Interference, undercutting for involute profile teeth, introduction to cycloidal profile, types of gear trains, kinematic analysis of gear trains including simple epicyclic and double epicyclic gear trains, Static force analysis, free body diagram, condition of equilibrium, Analysis of all links of given linkages, cams, gears mechanism and their combinations without friction.

Text Book:

1. Norton, R.L., Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education, 2013
2. Rattan, S. S., Theory of Machines, 3rd ed., Tata McGraw Hill Education, 2012.

Reference Books:

1. Uicker, J.J., Pennock, G.R. and Shigley, J.E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2013.
2. Bevan, T., Theory of Machines, 3rd ed., Pearson Education, 2012.
3. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 2nd ed., New Age International, New Delhi, 2012.
4. Ghosh, A. and Mallik, A.K., Theory of Mechanisms and Machines, 3rd ed., East-West Press, 2011.
5. Waldron, K.J. and Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, 2nd ed., John Wiley & Sons, 2004.
6. Ambedkar, A.G., Mechanism and Machine Theory, 3rd ed., Prentice Hall, 2011.

Course Code: **MEL 256**
Course Title: **MACHINE DRAWING**
Structure (L-T-P): **1-0-0**
Prerequisite: **MEL151**
Contents: Introduction to the generation of drawings as a design process for machine assembly. Sectioning, dimensioning and version control in drawings.

Standardized representation of threads, fasteners, welds, bearings, springs and related components.

Introduction to limits fits, and tolerances, dimensional and geometric tolerances, surface finish symbols.

Generation of assembly drawings including sectioning and bill of materials.

Evolving details of components from assembly considerations.Solid modeling of components involving shafts, bearing, pulleys, gears, belts, brackets, gearbox, plumber block and tailstock for assembly.

Text Book:

1. Naryana, K.L., Kannaiah, P. and Reddy, K.V. Machine Drawing, 4th ed., New Age International, 2013.

Reference Books:

1. Bureau of Indian Standards, Engineering Drawing Practice for Schools and Colleges, 1st ed., 1998
2. Bhatt, N.D. and Panchal, V.M., Machine Drawing, 47th ed., Charotar Publishing House, 2012.
3. PSG College of Technology, Design Data, 1st ed., DPV Printers, Coimbatore, 2002.
4. Junnarkar, N.D., Machine Drawing, Pearson Education, 2011.

Course Code: MEL257
Course Title: CASTING WELDING AND FORMING
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Contents: Casting: Casting Process and its classifications, Heating and Pouring, Fluidity, Porosity, Solidification and Cooling, Shrinkage, Riser and Gating Design, Sand Casting, Shell Moulding, Vacuum Casting, Investment Casting, Permanent Mould Casting - Die Casting, Squeeze Casting, Centrifugal Casting, Foundry Practices, Casting Quality, Product Design Considerations, Casting of Ferrous and Non-ferrous alloys, Economics of Casting, Shaping processes for plastics.

Welding: Classifications, Gas Welding and Cutting, Electric Arc Welding – Principle, Equipment and Electrodes, MMAW, Carbon Arc Welding, TIG, MIG, SAW, PAW, Resistance Welding – Spot, Seam, Upset, Flash, Welding Design, Welding Defects, Thermit Welding, Electroslag Welding, Electron Beam Welding, Laser Beam Welding, Forge Welding, Friction Welding, Diffusion Welding, Explosion Welding, Brazing and Soldering.

Metal Forming: Hot/Cold Working, Material Behaviour in MF, Strain Rate Sensitivity, Friction and Lubrication in MF, Rolling, Forging, Extrusion, Wire Drawing, Rod and Tube Drawing, Swaging, Sheet Metal Operations – Shearing, Drawing, Spinning, Bending, Embossing, Coining, Sheet Metal Die Design.

Text Book:

1. Kalpakjian S. and Schmid S.R., Manufacturing Engineering and Technology, 4th ed., Pearson Education, 2013.

Reference Books:

1. Groover M.P., Fundamentals of Modern Manufacturing: Material Processes and Systems, 3rd ed., Wiley India, 2011.
2. Rao P.N., Manufacturing Technology (Vol.1), 2nd ed., Tata McGraw Hill Education, 2012.
3. Ghosh A. and Malik A.K., Manufacturing Science, 2nd ed., Affiliated East-West Press Private Limited, 2010.
4. Bawa H. S., Workshop Technology, Tata McGraw Hill, 2001.

Course Code: MEL258
Course Title: MACHINING AND MACHINE TOOLS
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Contents: Metal machining: Chip Formation, Shear Zone, Orthogonal Cutting, Shear Angle and its Relevance, Cutting-Tool Geometry, Dynamometers, Cutting-Tool Materials, Thermal Aspects, Tool Wear and Tool Life, Surface Finish, Cutting Fluids, Empirical and Analytical Determination of Cutting Forces, Economics.

Cutting- Tool Materials and Cutting Fluids

Machining processes: Turning, Hole making, Milling, Broaching, Sawing, Filing, Gear Manufacturing, Abrasive machining and finishing operations

Non-Traditional Machining - Electric-Discharge Machining, Electrochemical Machining, Ultrasonic Machining, Chemical Machining, Laser-Beam Machining, Abrasive Water-Jet Machining (AWJM), Electron-Beam Machining (EBM), Ion-Beam Machining (IBM), Plasma-Arc Machining (PAM)

Text Book:

1. Kalpakjian, S. and Schmid, S.R., Manufacturing Engineering and Technology, 4th ed., Pearson Education, 2013.

Reference Books:

1. Groover, M.P., Fundamentals of Modern Manufacturing : Material Processes And Systems, 3rd ed., Wiley India, 2011
2. Rao, P.N., Manufacturing Technology (Vol.1), 2nd ed., Tata McGraw Hill Education, 2012
3. Ghosh, A. and Malik, A.K., Manufacturing Science, 2nd ed., Affiliated East-West Press Private Limited, 2010.
4. Boothroyd, G. and Knight, W.A., Fundamentals of Machining and Machine Tools, 3rd ed., CRC Taylor and Francis, 2013
5. Shaw M.C., Metal Cutting Principles, CBS Publishers, 2012.

Course Code: MEL351
Course Title: ENERGY CONVERSION TECHNIQUES
Structure (L-T-P): 3-0-0
Prerequisite: MEL202

Contents: Fundamentals and elementary treatment is expected to be covered in this course. Introduction to I.C. Engines: Two/Four stroke engine. SI and CI engines carburation and fuel injection.Indicated/brake power.Air standard, mechanical, thermal efficiencies.Compressors: Classifications, working principle. Reciprocating compressor: Ideal Cycles, multi stage compression, intercooling, condition for minimum work.Volumetric efficiency and power required. Introduction to Gas Turbines and Jet propulsion: Ideal cycles (open and close cycles), and working of turbojet, turboprop, ramjet & pulsejet, performance. Components of Steam power plant, their functions and processes involved there in. Such as boilers: Classification based on type of fuel, fire tube/water tube, and very high pressure boilers. Steam Turbines: Classifications, Velocity diagrams, Blade/Diagram efficiency. Condensers: Classifications, cooling tower. Law of Partial pressure, air leakage in condenser.Calculations of Condenser efficiency and vacuum efficiency. Introduction to Refrigeration and air conditioning: Vapor compression and vapor absorption system. Ideal Cycles, effect of Sub cooling and Superheating on C.O.P. and performance calculation. Psychometric chart and processes such as heating, cooling, humidification and dehumidification.

Text Books:

1. Eastop, T.D. and McConkey, A., Applied Thermodynamics: For Engineering Technologists, 5th ed., Pearson Education, 2013.
2. Nag, P.K., Power Plant Engineering, 4th ed., Tata McGraw Hill, 2014.

Reference Books:

1. Rogers, G.F.C. and Mayhew, Y.R., Thermodynamics and Transport Properties of Fluids, 5thed., Blackwell Publishers, 2013.
2. Ganesan, V., Internal Combustion Engines, 4th ed., Tata McGraw Hill Education, 2013.
3. Dixon, S.L. and Hall, C.A., Fluid Mechanics and Thermodynamics of Turbomachinery, 6thed., Elsevier, 2010
4. Arora, C.P., Refrigeration and air conditioning, 3rded., Tata McGraw Hill Education, 2013.
5. Yadav, R., Steam and Gas Turbines and Power Plant Engineering, 7th ed., Central Publishing House, 2012
6. Joel, R., Basic Engineering Thermodynamics, 5thed., Pearson Education, 2014.
7. Ballaney, P.L., Thermal Engineering, 5thed.,Khanna Publishers, 2012.
8. Heywood, J.B., Internal Combustion Engine Fundamentals, 1sted., Tata McGraw Hill Education, 2012.

Course Code: MEL352
Course Title: FLUID MACHINES
Structure (L-T-P): 3-0-0
Pre-requisite: MEL253

Contents: Introduction to Hydraulic Machines, Impulse momentum principle, dynamic action of jet on fixed and moving flat plates and curved vanes, series of plates and vanes, water wheels, velocity triangles and their analysis, jet propulsion of ships. Principles and classification of hydraulic machines, element of hydroelectric power plant. Hydraulic Turbine: impulse turbines i.e. Pelton wheel.

Reaction turbines i.e. Francis turbines, Propeller turbine, Kaplan turbine and bulb turbine.Principle of operation, construction, design, installation, characteristics, governing, accessories, selection, model testing, degree of reaction, velocity diagram and analysis, unit and specific quantities. Pump: centrifugal pump, reciprocating pump and rotary pumps. Principle of operation, classification, components installation, priming, velocity triangles and their analysis, slip factor, performance characteristics, multistaging of pumps, design, indicator diagram, cavitation, air vessels, model testing, NPSH, unit and specific quantities. Introduction to axial pump, mixed flow pump, self-priming pump, gear pump, sliding vane pump, screw pump & hand pump. Miscellaneous fluid machines: airlift pumps, hydraulic rams, hydraulic cranes, fluid couplings and torque converter.

Text Book:

1. Ojha C.S.P., Berndtsson R., Chandramouli P.N., Fluid Mechanics and Machinery, 1st ed., Oxford University Press 2010.
2. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, 3rded., Tata McGraw Hill Education, 2015.

Reference Books:

1. Yahya, S.M., Turbines, Fans and Compressors, 4thed., Tata McGraw Hill, 2012.
2. Lal, J., Fluid Mechanics and Hydraulics, 9th ed., Metropolitan Book Corporation .Private Limited, 2012.
3. Khan, M.K., Fluid Mechanics and Machinery, 1st ed. Oxford University Press India, 2015.
4. Nag, P.K., Power Plant Engineering, 3rded., Tata Mc-Graw Hill Education, 2013.
5. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 9thed., Laxmi Publication, 2014.

Course Code: MEL353
Course Title: HEAT AND MASS TRANSFER
Structure (L-T-P): 3-0-0
Pre-requisite: MEL252, MEL253
Contents: Modes of heat transfer in various applications. Conduction: Heat diffusion equation, 1-D steady state conduction in extended surfaces, infinite and semi-infinite walls, heat generation, lumped capacitance and simple transient models. Convection: Forced and free convection - mass, momentum and energy conservation equations, non-dimensional numbers, hydrodynamic and thermal boundary layers, basics of heat transfer in external and internal laminar and turbulent flows, and use of co-relations. Boiling and condensation: Physical phenomena and co-relations. Mass transfer: Fick's law, similarity with convection and correlations. Radiation: Properties, laws, 3- surface network for diffuse-gray surfaces, Heat exchanger fundamentals and design.

Text Books:

1. Cengel, Y.A. and Ghajar A. J., Heat and Mass Transfer, 5th ed., Tata McGraw Hill Education, 2015.
2. Incropera, F.P, and Others. Fundamentals of Heat and Mass Transfer,6th ed., Wiley India, 2013

Reference Books:

1. Holman, J. P.and Bhattacharyya, S., Heat Transfer, 10thed., Tata McGraw Hill Education, 2012.
2. Sukhatme, S.P., A Textbook on Heat Transfer, 4thed., Universities Press, 2013.
3. Ghoshdastidar, P.S., Heat Transfer, 2nded., 2012, Oxford University Press, 2012.
4. Nag, P.K., Heat and Mass Transfer, 3rded. Tata McGraw Hill Education, 2011.

Course Code: MEL354
Course Title: DYNAMICS OF MACHINES
Structure (L-T-P): 3-0-0
Prerequisite: MEL255
Contents: Dynamics: Concept of free body and its equilibrium, work-done-energy equation, general plane motion with translation and rotation, impulse-linear momentum, angular impulse-angular momentum, impact, generalized angular impulse-angular momentum, static force analysis, friction effects, D'Alembert's principle, dynamic force analysis, equivalent dynamical systems, simple gyroscopic motion.
Application: Gyroscopic effect and application, Flywheel and turning moment diagram, Dynamics of slider-crank mechanism, concept of offsets, governors and its types, brakes and dynamometer, Balancing of engines, analysis of friction devices (belt drives, pivots and collars, plate and cone clutches, band and block brakes), applications of Cam and follower.
Vibrations: Free vibration of single-degree-of-freedom undamped and damped systems, resonance, natural frequency, damping, forced vibration of single-degree-of-freedom systems, base excitation, vibration isolation, vibration transmission.

Text Books:

1. Uicker, J.J., Pennock, G.R. and Shigley, J.E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2013.

Reference Books:

1. Bevan, T., Theory of Machines, 3rd ed., Pearson Education, 2012.
2. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 2nd ed., New Age International, New Delhi, 2012.
3. Ghosh, A. and Malik, A.K., Theory of Mechanisms and Machines, 3rd ed., Affiliated East-West Press, 2011.
4. Rattan, S. S., Theory of Machines, 3rd ed., Tata McGraw Hill Education, 2012.
5. Norton, R.L., Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education, 2013.
6. Rao, J.S. and Gupta, K., Theory and Practice of Mechanical Vibration, 2nd ed., New Age International, 2012.
7. Meirovitch L., Fundamentals of Vibrations, 2nd ed., Waveland Press, 2010.
8. Waldron, K.J. and Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, 2nd ed., John Wiley & Sons, 2004.
9. Ambedkar, A.G., Mechanism and Machine Theory, 3rd ed., Prentice Hall, 2011.

Course Code: MEL355
Course Title: MEASUREMENT AND CONTROL
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Definition, need, Precision & Accuracy, Standards of Measurements, linear and angular measurements, Comparators: Mechanical, Fluid displacement & Pneumatic, Electrical, Screw thread measurement, Gear measurement.
Measurement of surface texture, straightness, flatness parallelism, circularity, Co-ordinate Measuring Machine (CMM), Automatic Gauging and Sorting machine, Interferometry: principle and types, optical flat Introduction, tolerances, interchangeability, selective assembly, limits & fits, types of fits, shaft basis system, hole basis system, allowances, IS specifications, Taylor principle, design of limit gauges. Limit gauges & its types, process planning sheet and tolerance chart preparation. Definition, function, objectives, concepts, characteristics, quality, quality of design & conformance, Statistical Quality Control, Process control charts & process capability, acceptance sampling techniques, sampling plans, inspection types and objectives Basics of ISO 9000 and ISO 14000, TQM concepts, quality assurance, quality circles.

Text Book:

1. Venkateshan, S.P., Meachincal Measurements, 2nd Ed., John Wiley and Sons Ltd., 2015.
2. Montgomery, D. C., Statistical Quality Control, 6th Ed., John Wiley and Sons Inc., 2009.

Reference Books:

1. Logonthesis, Managing for Total Quality: from Deming to Taguchi and SPC, Prentice Hall, 1997
2. Gitlow, H., Quality Management, 3rd ed., Tata McGraw Hill, 2005.

3. Grant, E.L. and Leavenworth, R.S., Statistical Quality Control, 7th ed., TataMcGraw Hill, 2000.
4. Feigenbaum, A.V., Total Quality Control, 4th ed., I.K International Publishing House, New Delhi, 2008.
5. Jain, R.K., Engineering Metrology, 20th ed., Khanna Publishers, 2013.

Course Code: **MEL356**
Course Title: **OPERATIONS MANAGEMENT**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Production systems and performance measures.Life Cycle of a production system, Major managerial decisions in the life of a production system, Just in Time (JIT), Theory of Constraints (TOC), Product design and process selection.Location and Layout of production systems, Product, Process and Cellular layouts, Demand Forecasting, Aggregate production planning, Inventory and MRP, Scheduling decisions and emerging trends.

Text Book:

1. Russell, R.S. and Taylor, B.W., Operations Management, 7th ed., Wiley India, 2013.

Reference Books:

1. Martinich, J.S., Production and Operations Management, Wiley India, 2009
2. Gaither, N. and Frazier, G., Operations Management, 9th ed., Cengage Learning, 2002.
3. Krajewski, L.J., Operations Management: Processes and Supply Chains withMyOMLab, Pearson Education, 2013.
4. Boeuf, M.L., Essence of Time Management, Jaico Publishing House, 2001.
5. Gupta, A.K. and Sharma, J.K., Management of Systems, Macmillan India Limited, 2010.

Course Code: **MEL357**
Course Title: **DESIGN OF MACHINE ELEMENTS**
Structure (L-T-P): **3-2-0**
Prerequisite: **MEL254, MEL255**
Contents: Introduction to Design of Machine Elements, Review of Failure theories, Introduction to design for fatigue strength, Endurance limit and modifying factors, surface strength, Design procedure for fatigue failure, Design of elements subjected to simple and fatigue loading, Design of Shafts and Couplings, Power Screws, Springs, Belts, Chain, Brakes, Bearing, Gears and Mechanical Joints.

Text Books:

1. Norton, R.L., Machine Design : An Integrated Approach, 2nd ed., Pearson Education, 2013
2. Bhandari, V. B., Design of Machine Elements, 4th ed., McGraw Hill, 2016.

Reference Books:

1. Spotts, M. F., Design of Machine Elements, 8th ed., Pearson Education India, 2006.
2. Black, P.H. and Adams, O.E., Machine Design, 3rd ed., McGraw Hill, Kogakusha, 1981.
3. Maleev, V.L. and Hartman, J.B., Machine Design, CBS Publishers and Distributors, 1983.
4. Schmid, S.R., Hamrock, B.J. and Jacobson B.O., Fundamentals of Machine Elements, 3rded., CRC Press, 2014.
5. Budynas, R.G. and Nisbett, J.K., Shigley's Mechanical Engineering Design, 9th ed., Tata McGraw Hill Education, 2013.
6. Juvinall, R. C. and Marshek, K. M., Machine Component Design, 5th ed., Wiley India, 2012.

Course Code: **MEL358**
Course Title: **METROLOGY AND SQC**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Mechanical Measurements: Purpose, structure and elements of measuring system, Static performance characteristics, Generalized model of system element and calibration, linearity, static sensitivity, accuracy, precision, repeatability, hysteresis, threshold, resolution and readability. Measurement error: Sources of errors, error analysis, propagation of uncertainties, theory of experimentation. Dynamic Performance characteristics, Input types, instrument types, zero, first, and second order instruments. Measurements and methods applications: Classification, Principle, Construction, Range and working of instruments for following measurements, Displacement, Speed, Force, Torque, Temperature, Flow, Level, Pressure, Sound, Light intensity. Classical Control: Laplace Transformation, Block diagram and its reduction, Time response, Root Locus Analysis, Routh Stability, Frequency response, Bode, Polar, Nyquist, Nichols charts, Nyquist stability, Compensation: Lead, Lag, Lead-Lag, PID controller. Modern Control: State space method, Signal Flow Graph (SFG), State Transition Matrix, Stability, Steady state error. Advanced Control: Digital control, z-transformation, Digital transformation, Stability, Performance plot, Root Locus, Compensation, PID controller, Robust control, Concept of system sensitivity, Sensitivity function, Perturbation: additive, multiplicative, Robust stability, Uncertain system and its stability, Robust PID controller

Text Books:

1. Doeblin, E.O. and Manik, D. N., Doeblin's Measurement Systems, 6th ed., McGraw Hill, 2012
2. Nakra, B.C and Chaudhry, K.K., Instrumentation Measurement and Analysis, 3rd ed., Tata McGraw Hill, 2013

Reference Books:

1. Bentley, J.P., Principles of Measurement Systems, 4th ed., Pearson Education, 2011.
2. Beckwith, T.G, Lienhard, V J.H., and Morangoni, R.D., Mechanical Measurements, 6th ed., Pearson Education, 2012.
3. Rangan, C.S., Sarma, G.R. and Mani, V.S.V., Instrumentation Devices and Systems, 2nd ed., McGraw Hill, 2011
4. Bewoor, A K. and Kulkarni, V.A., Metrology and Measurement, McGraw Hill, 2012
5. Dally, J.W., Riley, W. F. and Meconnell, K. G., Instrumentation for Engineering Measurements, 2nd ed., Wiley India, 2012.
6. Ogata K., Modern Control Engineering, 5th ed., Pearson Education,2015.
7. Dorf, R. C., & Bishop, R. H., Modem control systems., 6th ed., Addison-Wesely Publishing, Reading, MA, 1995.
8. Nagrath, I. J., Control systems engineering. New Age International, 2006.

Course Code: **MEL451**
Course Title: **REFRIGERATION AND AIR CONDITIONING**
Structure (L-T-P): **3-0-0**
Pre-requisite: **MEL253, MEL353**
Contents: Fundamentals of refrigeration and air conditioning. Vapor compression system: Ideal and real cycle analyses, Refrigerants: designation, properties, and environmental considerations. Actual vapor compression cycles, Multi-stage compression. Air refrigeration cycle Components: condensers, evaporators, compressors and expansion devices – construction, operation and performance. Vapor absorption cycles: operation, system design, components. Psychrometry: definitions, heating, cooling, humidification and dehumidification processes, evaporative cooling systems. Environmental comfort specifications and standards.

Cooling load estimation and use of standards. Air-conditioning systems and apparatus, air flow ducts, air quality. Control and optimization of HVAC systems.Applications and environmental issues.

Text Book:

1. Arora, C.P., Refrigeration and Air Conditioning, 3rd ed., Tata McGraw Hill Publication, 2013.
2. Prasad, M., Refrigeration and Air Conditioning, 2nd ed., New Age International Publishers, 2006.

Reference Books:

1. Dossat, R.J., Principles of Refrigeration, 4th ed., Pearson Education, 2010.
2. Ballaney, P.L., Refrigeration and Air Conditioning, 7th ed., Khanna Publishers, 1992.
3. Khurmi, R.S. and Gupta, J.K., Textbook of Refrigeration and Air Conditioning, 5th ed., S. Chand Publication, 2011.
4. Arora, S.C. and Domkundwar, S., A Course in Refrigeration and Air Conditioning, 7th ed., DhanpatRai and Co., 1999.
5. Pita, E.G., Air Conditioning Principles and Systems: An Energy Approach, 4th ed., PHI Learning Private Limited, 2008.
6. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013 Ashrae Handbook: Fundamentals, Inch-Pound ed., ASHRAE, 2013.

Course Code: **MEL452**
Course Title: **MECHANICAL VIBRATIONS**
Structure (L-T-P): **3-0-0**
Prerequisite: **MEL354**

Contents: Fundamentals of Vibration: Basic concepts of vibration, classification, importance, vibration analysis procedure.

Single degree of freedom system: Free vibration analysis of undamped translational and torsional system, Rayleigh's energy method, Free vibration with various types of dampings (viscous, coulomb, hysteresis), Free vibration response under harmonic and other general forcing conditions, transient response through Du-hamel's integral.

Two degree of freedom systems: Free vibration analysis of damped and undamped translational and torsional system, Coordinate coupling and principle coordinates, Semi-defined system.

Multi degree of freedom systems: Modeling of continuous systems as multi degree of freedom system using Newton's second law, Influence coefficients, eigenvalue problem, forced vibration of undamped and damped systems using modal analysis.

Determination of natural frequencies and mode shapes: Dunkerley's formula, Rayleigh's method, Jacobi's method.

Vibration of Continuous systems: Longitudinal vibration of bar/rod, lateral vibration of beams and torsional vibration of shafts.

Vibration Control: Control of vibration, control of natural frequencies, vibration isolation and absorbers.

Vibration measurement and applications: Role of vibration measurement and analysis in machine design and machine condition monitoring.

Text Book:

1. Rao, S.S., Mechanical Vibrations, 4thed., Pearson Education, 2012.
2. Grover, G.K, Mechanical Vibrations, 8th ed., Nem Chand & Bros, 2009.

Reference Books:

1. Rao, J. S. and Gupta, K., Introductory Course on Theory and Practice of Mechanical Vibrations, 2nd ed., New Age International Publishers, 2012.
2. Meirovitch L., Fundamentals of Vibrations, 2nd ed., Waveland Press, 2010.
3. Timoshenko, S., Vibration Problems in Engineering, 2nd ed., Oxford City Press, 2011
4. Thomson, W.T. and Dahleh, M.D., Theory of Vibration with Applications, 5th ed., Pearson, 2014.

Course Code: **MEL453**
Course Title: **OPERATIONS RESEARCH**
Structure (L-T-P): **3-2-0**
Prerequisite: **NIL**

Contents: Introduction to OR & basic OR models, definition, characteristics and limitations of OR, linear programming: solutions of LPP by graphical method and simplex method, formulation of dual of LPP. Assignment model, travelling salesman problem, transportation Problems, transhipment model. Dynamic programming, structure and characteristics of dynamic programming, application of dynamic programming to resource allocation, inventory control & linear programming, Project management: drawing of network, CPM & PERT, Probability of completion of project, cost analysis of project, allocation and updating of networks.

Replacement models: concept of equivalent, interest rate, present worth, economic evaluation of alternatives, group replacement models. Inventory control models, analysis of single product deterministic models. Waiting line situations, queuing theory and models (no derivations expected). Simulation concept and its application in waiting line situations, inventory and networks

Text Book:

1. Taha, H.A., Operations Research: An Introduction, 9th ed., Pearson Education, 2013.

Reference Books:

1. Sharma, J.K., Operations Research, 4th ed., Macmillan India Ltd., 2009.
2. Vohra, N.D, Quantitative Techniques in Management, 4th ed., Tata McGraw Hill, New Delhi, 2011.
3. Hillier, F.S. and Lieberman, G. J., Introduction to Operations Research, 10th ed., McGraw Hill, 2014.
4. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand and Co. Ltd., 2012.

Course Code: **MEL454**
Course Title: **INDUSTRIAL ENGINEERING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**

Contents: Organization: Factory system, principles of organization, types of organization and their selection. Work study: Introduction, Scientific management – Productivity - Advantages of work study to Management. Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study. Ergonomics: Basics of Ergonomics and its industrial applications, Anthropometry. Principles of Motion Economy: Related to human body, work place, equipment. Work Measurement: Work measurement techniques – Rating - Measuring the job – Allowances - Standard time - Synthetic data - Analytical estimating – PMTS, Work factor, MTM, Activity sampling, Its applications. Job analysis, Job Evaluation, Techniques of job evaluation - Merit rating – Incentive plans, Value engineering and analysis. Industrial Relations: Labour welfare, wage and incentives, absenteeism and labour turnover. Quality and Quality Control: Types of inspections, statistical quality control; Control charts for variables and attributes: X bar, R, p and c charts; Sampling, concepts and scope of TQM and QFD.

Text Books:

1. Buffa, E.S., and Sarin, R.K., Modern Production / Operations Management, John Wiley & Sons, 1994.

Reference Books:

1. Kanawaty, G., Introduction to work study, International Labour Organization, 1992.
2. Barnes R.M., Motion and Time Study; Design and Measurement of Work, John Wiley, 1980.
3. Bridger, R., Introduction to ergonomics. Crc Press, 2008.

4. Jocobs, C.A., Production and Operations Management, Tata McGraw-Hill, 1999.
5. Maynard, H.B., Industrial Engineering Handbook, McGraw-Hill, 2001.

Course Code: **MEL455**
Course Title: **FLUID DYNAMICS**
Structure (L-T-P): **3-0-0**
Pre-requisite: **MEL253**
Contents: Basic of fluid kinematics, Concept of boundary layer,General properties of boundary layer,flow over a flat plate, Reynolds Transport theorem, Navier-Stokes's equations and it's applications, Von-Karmann momentum equation, Exact solution using two dimensional method, Correlation coefficient, Concept of compressible flow, one dimensional isentropic flow, normal shock, Oblique shock, flow with frictional heat transfer.

Text Book:

1. Yahya, S.M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 4th ed., New Age International, 2012.
2. Som, S. K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd ed., Tata McGraw Hill Education, 2012.

Reference Books:

1. White, F.M., Fluid Mechanics, 7th ed., Tata McGraw Hill Education, 2013.
2. Kundu, P. K., Cohen I. M. and Dowling, D.R., Fluid Mechanics, 5thed, Elsevier, 2013
3. Streeter, V.L., Wylie E.B. and Bedford, K.W., Fluid Mechanics, 9thed., Tata McGraw Hill Education, 2011.

Course Code: **MEL456**
Course Title: **COMPUTER AIDED DESIGN**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Introduction to computer aided design, brief history. Two and three-dimensional transformations: Introduction, representation of points, transformation of points and straight lines, rotation, reflection, scaling, combined transformations, translations and homogeneous coordinates and associated transformations; affine and perspective geometry, transformations for parallel and perspective projections.

Design of curves: Introduction, wireframe models and curve representation.

Plane curves: non-parametric and parametric curves; Space curves: representation of space curves, cubic splines, normalized cubic splines, Bezier curves, B-spline curves, rational B-spline curves.

Design of surfaces: Introduction, surface models and surface representation, surface of revolution, sweep surfaces, quadric surface, bilinear surface, ruled and developable surface, brief introduction of the following surface patches: linear Coons surface, Coons bicubic surface, Bezier surface, B-spline surface, Rational B-spline surface.

Solid modeling: Introduction, solid models and solid representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), half spaces and other representations.

Text Books:

1. Rogers, David F. and Adams, J. Alan, Mathematical Elements for Computer Graphics, McGraw-Hill, 2nded., 2005 .
2. Zeid, Ibrahim and Sivasubramanian, R., CAD/CAM: Theory and Practice, 2nded., McGraw Education, 2010.

Reference Books:

1. Faux, I.D. and Pratt, M.J., Computational Geometry for Design and Manufacture, Ellis Horwood Limited (a division of John Wiley & Sons), 1987.
2. Rooney, J. and Steadman P., Principles of Computer-aided Design, Affiliated East-West Press Pvt Ltd.
3. Mortenson, Michael E., Geometric Modeling, 3rd Ed., John Wiley & Sons, 2006
4. Foley, J.D., van Dam, A., Feiner, S.K. and Hughes, J.F., Computer Graphics: Principles and Practice, Pearson Education.
5. Hearn, Donald and Baker, M. Pauline, Computer Graphics, Prentice Hall of India.
6. Rao, P. N., CAD/CAM: Principles and Applications, 3rd Ed., McGraw Hill Education (India) Pvt Ltd, 2010.

Course Code: **MEL457**
Course Title: **COMPUTER INTEGRATED MANUFACTURING**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation.

Programmable control – Introduction, NC controller technology, computer numerical control combined with DNC/CNC systems, adaptive control machining systems.

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP).

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method.

Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Text Book:

1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3rd. ed., Pearson Education, 2014

Reference Books:

1. Ranky, P.G., The Design and Operation of FMS: Flexible Manufacturing Systems, IFS, 1983.
2. Harrington, J., Computer Integrated Manufacturing, Krieger Publication, 1985.
3. Shover, R.N., An Analysis of CAD/CAM Application with Introduction to CIM, Prentice Hall.
4. Bedworth, D.D. and et.al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991
5. Scholz-Reiter, B., CIM Interfaces, Chapman and Hall, 1992.
6. Goetsch, D.L., Fundamentals of CIM Technology: Automation in Design, Drafting and Manufacturing, Delmar Publication, 1988.

Course Code: **MEL458**
Course Title: **MECHATRONICS**
Structure (L-T-P): **3-0-0**
Prerequisite: **NIL**
Contents: System Integration, Scope of Mechatronics, Measurement system, open and closed loop system, architecture of mechatronic system, approach towardsmechatronic design. Basic electrical terminologies, basic electrical elements, semiconductor electronics, junction diode, Bipolar junction transistor, Field effect transistor. Function of Sensors, Performance terminology. Displacement / Position Sensors, Proximity sensors, Velocity / Motion sensors, Force Sensors, Temperature sensors, Fluid pressure sensor, Light sensors. Factors for selection of sensors.Purpose of signal

conditioning.Interfacing with a microprocessor, Signal conditioning processes, protection circuits.A/D converters, D/A converter, Multiplexer, Data Acquisition.Analog and Digital Indicators, Digital display, Alarm Indicators, Recorders, magnetic recording. Hydraulic/Pneumatic Actuation: Power supplies, Direction control valves, Pressure control valves, Cylinders, Process control valves, Rotary actuators. Mechanical Actuation: Types of motion, Kinematic chain, cams, gears, belt and chain drives, ratchet and pawl, Geneva mechanism. Electrical Actuation: Switching devices, solenoids, electrical motors i.e. A.C. motor and its types, D.C. motor and its types, stepper motor. Continuous and discrete processes, control modes.Proportional mode, derivative mode, integral mode, PID controllers, adaptive control.Digital controllers. Logic gates, Boolean algebra, application of logic gates, sequential logic, logic families, Fuzzy logic. Microcomputer Structure, Micro controller, Applications and Programming.Basic structure of PLC, Input/Output processing, PLC programming, mnemonics, selection of PLC.Digital communication and interfacing.

Text Book:

1. Bolton, W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th ed., Pearson Education, 2013.

Reference Book:

1. Alciatore, D.G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, 4th ed., McGraw Hill, 2012.

Course Code: **MEL459**
Course Title: **GAS TURBINE AND COMPRESSOR**
Structure (L-T-P): **3-0-0**
Prerequisite: **MEL351**
Contents: Introduction to gas turbines and compressor, its classification and application, Gas Turbine Cycles: Ideal and actual cycles, multi-stage compression, reheating, regeneration, combined and cogeneration. Energy transfer between fluid and rotor, axi-symmetric flow in compressors and gas turbines.Centrifugal Compressors: Principles of operation, compressor losses, adiabatic efficiency, slip factor, pressure coefficient, power unit and design consideration for impeller and diffuser systems, performance characteristics. Axial Flow Compressors: Elementary theory, vortex theory, degree of reaction, simple design, elementary air-foil theory, isolated airfoil and cascade theory, three dimensional flow, stages, stage efficiency and overall efficiency, performance characteristics. Turbines: Axial flow and radial flow turbines, impulse and reaction turbines, fundamental relations and velocity triangles, elementary vortex theory, limiting factors in turbine design, application of airfoil theory to the study of flow through turbine blades, aerodynamic and thermodynamic design considerations, blade materials, blade attachment and blade cooling.
Gas Turbine Power Plants: Fuel and fuel feed systems, combustion systems-design considerations and flame stabilization, regenerator types and design, gas turbine power plant performance and matching, application

Text Books:

1. Saravanamuttoo, H.I.H., Rogers, G.F.C., Cohen, H. andStraznicky, P.V., Gas Turbine Theory, 6th ed., Pearson Prentice Hall, 2008.
2. Ganesan, V. Gas Turbines, 3rd ed., Tata McGraw-Hill Education, 2010.

Reference Books:

1. Bathie, W. W., Fundamentals of Gas Turbines, 2nd ed., John Wiley & Sons, 1995.
2. Lefebvre, H. and Ballal, D. R., Gas Turbine Combustion, 3rd ed., CRC Press, 2010.

Course Code: MEL 460
Course Title: QUALITY ASSURANCE
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents: Introduction to quality assurance and quality control, Various elements in Quality Assurance program, On-line and Off-line quality control, Statistical concepts in quality, probability distributions, Central limit theorem, Chance and assignable causes of quality variation, Process control charts for variables, Control chart parameters, Target process setting/Centering, Control limits and specification limits. Process capability studies, Capability indices, Quality remedial/Corrective actions, Special purpose control charts, Reject limits, Variables inspection and attributes Inspection, Quality rating, Defects classification, Average run length. Economics of product inspection, Quality costs, ISO 9000 quality system, Product quality and reliability, Failure data analysis and life testing. Problems and illustrations in Quality Assurance, Automatic gauging, automatic measuring machines for inspecting multiple workpiece dimensions, measurement with coordinate measuring machines.

Text Book:

1. Mitra A., Fundamentals of quality control and improvement, John Wiley & Sons, 2016.

Reference Books:

1. Leavenworth R.S., Grant E.L., Statistical Quality Control, Tata McGraw-Hill Education, 2000.
2. Bestefield D.H., Quality Control, Prentice Hall, 2003.
3. Feigenbaum A.V., Total Quality Control, McGraw-Hill, 1983.

Course Code: MEL 461
Course Title: ROBOTICS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Common Robot configurations, coordinate system, work envelop, Elements of robotic system, actuators, controller, teach pendant, sensors, Specification of robots, Applications.
Robot Kinematics: Forward and reverse Kinematics of 3 DOF Robot arms, Homogeneous transformations, Kinematics equation using homogeneous transformations.
Actuators: Hydraulic actuators, Pneumatic actuator, Electrical actuators, Directional control, Servo Control Flow control valves.
End Effectors: Classification of end effectors, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive Grippers, force analysis in Grippers.
Sensors: Need for sensing systems, Sensory devices, Types of sensors, Robot vision system. Robot Programming: Types of Programming, Motions Programming, Robot Languages - VAL systems.

Text Book:

1. Groover, M. P., Industrial Robotics: Technology, Programming and Applications, 2nd ed., Tata McGraw Hill, 2013.

Reference Books:

1. Deb, S. R., Robotics Technology and Flexible Automation, 2nd ed., Tata McGraw Hill, 2010
2. Niku, S., Introduction to Robotics: Analysis, Control, Applications, 2nd ed., Wiley, 2011.
3. Radhakrishnan, P., Subramanyan, S. and Raju, V., CAD/CAM/CIM, 3rd ed., New Age International Publishers, 2011
4. Koren, Y., Robotics for Engineers, 2nd ed., McGraw Hill, 1987.

Course Code: MEL 462
Course Title: AUTOMATION IN PRODUCTION
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing, Different types of production systems and automation, hard/fixed automation including process automation, Rapid prototyping and tooling. Hydraulic and pneumatic actuators, their design and control devices, sequence operation of

hydraulic/pneumatic actuators, designing of complete systems with hydraulic, electro-hydrolic and digital control devices, applications in manufacturing, material handling systems, feeders, orienting and escapement devices, their analysis and design, Automatic assembly machines, designing for automatic assembly.

Text Book:

1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3rd. ed., Pearson Education, 2014.

Reference Books:

1. Grover, M.P. and Zimmers, E.W., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008.
2. Kundra, T.K., Rao, P.N. and Tewari, N.K., Computer Aided Manufacturing, Tata McGraw Hill, 2010.
3. Koren, Y., Computer Control of Manufacturing Systems, 3rd ed., Tata McGraw Hill, 2005.

Course Code: MEL 463
Course Title: POWER PLANT ENGINEERING
Structure (L-T-P): 3-0-0
Pre-requisite: MEL351
Contents:

Introduction to power systems and technologies, Demand variation and forecasting, Diesel generators: Systems, equipment and layout. Fossil-fuelled steam power plants: Boiler and accessories, turbine and accessories, feed cycle equipment, generator. Combined cycle power plants: Gas turbine, heat recovery boiler. Nuclear power: Nuclear reactions, fuel, moderator and coolant, neutron life cycle. Reactors: Light water, heavy water, gas-cooled and fast reactors. Hydroelectric plants: Features and siting, Pelton, Francis, Kaplan and propeller turbines construction, mini- and micro-turbines. Introduction to renewable energy sources, Co-generation systems, Environmental issues, sustainability and future scenarios.

Text Book:

1. Nag, P.K., Power Plant Engineering, 4th ed., Tata McGraw Hill, 2014.
2. El-Wakil, M.M., Power Plant Technology, 4th ed., Tata McGraw Hill, 2011.

Reference Books:

1. British Electricity International, Modern Power Station Practice, 3rd ed., Pergamon Press, 1992.
2. Babcock and Wilcox Company, Steam: Its Generation and Use, 36th ed., Kessinger Pub. Co., 2008.
3. O'Hayre, R.P. and et. al., Fuel Cell Fundamentals, 2nd ed., John Wiley and Sons, 2009.
4. Skrotzki, B.G.A. and Vopat, W.A., Power Station Engineering and Economy, Tata McGraw Hill, 2009
5. Arora, S.C. and Domkundwar, S., A Course in Power Plant Engineering, 3rd ed., DhanpatRaiand Sons, 1988.
6. Frederick, T.M., Power Plant Engineering, 3rd ed., East-West Press, 1989.
7. Woodruff, E.B., Lammers, H.B. and Lammers, T.F., Steam Plant Operation, 9th ed., McGraw Hill, 2012

Course Code: MEL 464
Course Title: RENEWABLE ENERGY SOURCES
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Need for alternative sources of energy, various options available, principles of energy conversion using solar energy, wind energy, Ocean energy, Geothermal energy and MHD power generation. Introduction, Spectral distribution of solar radiation, beam and diffused radiations, Liquid flat plate collector & their analysis, collector efficiency factor and heat removal factor, Solar air heaters and their analysis. Solar tracking system and Solar energy storage. Water heating, space heating, drying, refrigeration, distillation, cooking, PV systems. Introduction to biogas generation, fixed dome & floating drum biogas plants, their constructional details, factors affecting generation of biogas, utilization of biogas. Introduction, methods of obtaining energy from biomass, inceneration, thermal gasification.Up draft and down draft gasifiers, their constructional details, Applications of producer gas.Power in wind, basic principles of wind energy conversion, basic components of WEC Systems, Savonius and Darrieus rotors, application of wind energy. Introduction, Ocean Thermal Electric Conversion (OTEC), open and closed cycle of OTEC, hybrid cycle, energy from tides, generation components of tidal power plants, single and double basin design arrangement, estimation of tidal power and energy.

Text Book:

1. Rai, G.D., Non-Conventional Sources of Energy, 4th ed., KhannaPublishers, 2009.
2. El-Wakil, M.M., Power Plant Technology, 4th ed., Tata McGraw Hill, 2011.

Reference Books:

1. Beckman, W.A. and Duffie, J.A., Solar Engineering of Thermal Processes, John Wiley & Sons, 2013
2. Sukhatme S.P. and Nayak J. K., Solar Energy: Principles of Thermal Collection and Storage, 3rd ed., Tata McGraw Hill, 2013.
3. Parulekar, B.B. and Rao, S., Energy Technology, 3rded.,Khanna Publishers, 1995.
4. Garg, H.P. and Prakash J., Solar Energy: Fundamentals and Applications, 8th ed., Tata McGraw Hill, 2007.
5. Khandelwal, K.C. and Mahdi, S.S., Biogas Technology: A Practical Handbook, 1st ed., Tata McGraw Hill, 1988.

Course Code: MEL 465
Course Title: AUTOMOBILE ENGINEERING
Structure (L-T-P): 3-0-0
Pre-requisite: MEL301
Contents:

Brief history of automobile development, present scenario of automobiles in India and abroad.Chassis, articulated and rigid vehicles, vehicles layout. Engine construction: structural components and materials, Steering system: principle of steering, centre point steering, steering linkages, geometry and wheel alignment, power steering, special steering systems. Tyres specifications, factors affecting tyre performance, special tyres, wheel balancing, Suspension system: function of spring and shock absorber, conventional and independent suspension system, telescopic shock absorber, Clutch: requirements of a clutch system, types of clutches. Transmission: necessity of transmission, principle, types of transmission, sliding mesh, constant mesh, synchromesh, transfer gear box, gear selector mechanism, propeller shaft, universal joint, constant velocity joint. Differential: need and types of rear axle and front axles. Brakes: mechanical brakes, hydraulic, pneumatic brakes, electrical brakes, engine exhaust brakes, drum and disc brakes, comparison.

Introduction to hybrid and electric vehicles: Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.Basic concept of electric traction, introduction to various electric drive-train.

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis,

Text Book:

1. Singh K., Automobile Engineering (Vol. I & II), 13th ed., Standard Publishers and Distributors, 2012.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. Ramalingum, K.K., Automobile Engineering, 2nd ed., Scitech Publications, Chennai, 2011.
2. Srinivasan, S., Automotive Engines, 2nd ed., Tata McGraw Hill, New Delhi, 2004.

3. Crouse, W.H. and Anglin, D.L., Automotive Mechanics, 10th ed., Tata McGraw Hill, 2007.

Course Code: MEL 466
Course Title: I. C. ENGINES
Structure (L-T-P): 3-0-0
Pre-requisite: MEL351
Contents:
Thermodynamics of fuel-air cycles, actual cycles.Ignition, normal and abnormal combustion in SI and CI engines.Conventional and alternative fuels for engines.Conventional and electronic fuel management systems for SI and CI engines.Design of combustion chamber for SI and CI engines.Engine emissions.Lubrication, cooling. Supercharging and turbocharging. Modern developments in IC engines.
Text Book:
1. Ganesan, V., Internal Combustion Engines, 4th ed., Tata McGraw Hill, 2013.
2. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw Hill, 2012.
Reference Books:
1. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1974.
2. Dankundwar, A.V., Course in Internal Combustion Engines, DhanpatRai and Sons, 2002.
3. Mathur, M.L. and Sharma, R.P., Course in Internal Combustion Engines, 8th ed., Dhanpat Rai and Sons, 2003.
4. Pulkrabek, W.W, Engineering Fundamentals of the Internal Combustion Engine, 2nd ed., Pearson Education, 2014.

Course Code: MEL467
Course Title: TOOL DESIGN
Structure (L-T-P): 3-2-0
Pre-requisite: NIL
Contents:
Tool design procedure, Tool making practices, Tooling materials and heat treatment, Cutting tools design, Locating and clamping methods, Design of drill jigs, Design of fixtures, Design of sheet-metal bending, forming and drawing dies, Design of sheet-metal blanking and piercing dies.
Text Book:
1. Donaldson, C. and et.al., Tool Design, 4th ed., Tata McGraw Hill, New Delhi, 2013.

Course Code: MEL468
Course Title: MACHINE TOOL DESIGN
Structure (L-T-P): 3-2-0
Pre-requisite: NIL
Contents:
Design requirements of machine tools. A design approach for machine tools. Identification and quantification of objectives and constraints in machine tool design. Estimation of power requirements and selection of motor for metal cutting machine tool spindles. Design of gearbox, spindle and guideways. Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and overarms to achieve desired static & fatigue strength, stiffness, dynamic characteristics and other requirements. Exercises on the design of machine tools using existing CAD software packages.Introduction to computer integrated manufacturing systems and CNC machine tools. Design/selection of linear motion systems, ball, screws, CNC feedback devices, controllers, feed drives and servomotors for CNC machine tools.Recent developments in CNC and other machine tools.
Text Book:
1. Basu, S.K., and Pal, D.K., Design of Machine Tools, 5th ed., Oxford and IBH Publishing House, 2011
Reference Book:
1. Mehta, N.K., Machine Tool Design and Numerical Control, 3rd ed., Tata McGraw Hill, 2012.

Course Code: MEL469
Course Title: MATERIAL RESOURCE PLANNING
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:
Role of materials management techniques in material productivity improvement, cost reduction and value improvement. Purchase management, incoming material control. Acceptance sampling and inspection.Vendor rating system.Inventory management, various inventory control models.aterial requirement planning systems.Discrete lot sizing techniques.Wagner and whitin algorithm.Silver-Meal algorithm. Algorithms for multi-product lot sizing with constraints inventory management of perishable commodities. Design of inventory distribution systems. Inventory management in Kanban and Just-in-time.
Reference Books:
1. Gopalakrishnan, P., Purchasing and Materials Management, TMH, New Delhi, 2010.
2. Tersine, R.J., Material Management and Inventory Systems, North Holland, New York, 1979.

Course Code: MEL 470
Course Title: COMPUTER INTEGRATED MANUFACTURING
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation.
Programmable control – Introduction, NC controller technology, computer numerical control combined with DNC/CNC systems, adaptive control machining systems.
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP).
Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method.
Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Text Book:
1. Groover M.P., Automation, Production Systems and Computer Integrated Manufacturing, 3rded., Pearson Education, 2014
Reference Books:
2. Ranky, P.G., The Design and Operation of FMS: Flexible Manufacturing Systems, IFS, 1983.
3. Harrington, J., Computer Integrated Manufacturing, Krieger Publication, 1985.
4. Shover, R.N., An Analysis of CAD/CAM Application with Introduction to CIM, Prentice Hall.

5. Bedworth, D.D. and et.al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991
6. Scholz-Reiter, B., CIM Interfaces, Chapman and Hall, 1992.
7. Goetsch, D.L., Fundamentals of CIM Technology: Automation in Design, Drafting and Manufacturing, Delmar Publication, 1988.

Course Code: MEP 471
Course Title: MACHINE SYSTEM DESIGN LAB
Structure (L-T-P): 0-0-4
Pre-requisite: NIL
Contents:

Design of a small Mechanical system consisting of shaft, bearing, gear/belt. Only output expected shall be provided. Complete concept shall be developed by students. Final report shall consist of concept, Power and Force calculations, Component design report, Production Drawing of compounds, Assembly and sub assembly drawing of components.

This task can be done by a group of not more than 3 students

Text Book:

1. PSG Design Data Book.

Course Syllabi (Under Graduate)

Department of Chemistry

Course Code: SCL155
Course Name: APPLIED CHEMISTRY
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Quantum Chemistry: Operators, Eigen functions & Eigen values, Schrodinger Equation & its applications, Particle in a box, wave function for hydrogen atom, Atomic orbital and molecular orbitals.

Kinetics: Rate of chemical reaction, Factors influencing rate of reactions, Order & molecularity of reactions, 1st, 2nd and Zero order reactions, Study of kinetics of reaction: Hydrolysis of EtOAc, Concept of activation energy, Significance, Arrhenius equation, Effect of catalyst and temperature on reaction rate, Theory of absolute reaction rates, Chain reaction, Enzyme Kinetics.

Electrochemistry: Introduction, Arrhenius ionic theory, Debye-Huckel theory of strong electrolytes, conductance, specific conductance and equivalent conductance, Ostwald's dilution law, Different concepts of acids & bases concept of pH & pOH, Buffer solution, Henderson-Hasselbalch equation, common ion effect. Conductometric titration.

Corrosion: Dry & wet corrosion, mechanism of wet corrosion, galvanic corrosion, concentration cell corrosion, pitting corrosion, waterline corrosion, Electrochemical Series, Factors influencing corrosion, Corrosion control.

Co-ordination Chemistry: Properties, coordination compounds, Terms used in Co-ordination Complex, Nomenclature of complex compounds, Valence bond theory, Explanation of formation of some complex, Crystal field theory, Crystal field splitting in octahedral and tetrahedral complex, Catalysis by metal salts: Wilkinson's catalyst, Role of metal ions in Biological systems: Structure of Hemoglobin.

Stereochemistry: Stereochemistry, geometrical isomerism, optical activity, Optical Isomerism, diastereomers, Optical activity without asymmetric carbons, *E*, *Z* & *R*, *S* System of nomenclature.

Nano Chemistry: Synthesis of nanoparticles, Nano molecules, applications.

Green Chemistry: Introduction, Goal & signification, Basic Components, Alternative feedstock's, alternative regents, Alternative reaction conditions, atom economy, optimization of frameworks for greener synthetic pathways, Industrial applications of green chemistry.

Text books:

1. Kuriacose, J. C., Rajaram, J., *Chemistry in Engineering and Technology*; Vol. I & II, Mc.GrawHill
2. Jain & Jain, *Engineering Chemistry*, 15th ed. Dhanpat Rai Publishing Company (P) Ltd., 2012.

Reference Books:

1. Narula, A. K., Vermani O. P., *Industrial Chemistry*; Galgotia Publication.
2. Alanna, O. G., *Engineering Chemistry*; Mc Graw Hill.
3. Vairam, S., *Engineering Chemistry*; Wiley India.
4. Dara, S. S., *A Textbook of Engineering Chemistry*; S. Chand & Company Ltd. New Delhi.

Course Code: SCL464
Course Name: ENGINEERING CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Polymer Science: Nomenclature, Types of Polymerization, Classification of Polymers, bonding in polymers, Mechanism of Polymerization, stereochemistry of polymers, molecular weight of polymer, methods of polymerization-free radical, anionic, cationic and coordination polymerization, Characterization of polymers, thermoplastic (low and high density polythenes PMMA) and thermosetting resins (bakelite, epoxy), PVC (Polyvinyl chloride), PVA (polyvinyl acetate), rubbers (natural and synthetic) Inorganic polymers- preparation and uses of silicones.

Water Chemistry: Sources, hard & soft water, Temporary & Permanent hardness, Units of Hardness, Disadvantages of hard water, Scale & Sludge formation in boilers, estimation of hardness by EDTA method, softening of water, zeolite process & demineralization by ion exchangers, specifications for drinking water, treatment of water for domestic use, desalination - Reverse Osmosis & Electrodialysis, industrial waste water treatment.

Lubricants: Lubricants - Definition, theories of lubrication, characteristics of lubricants, viscosity, viscosity index, oiliness, pour point, cloud point, flash point, fire point, additives to lubricants, Solid lubricants.

Dyes: Introduction, Classification, Azo dyes, Triarylmethane dyes, Malachite Green, Rosaniline, Phenolphthalein, Alizarin, Methylene Blue, Other uses of Dyes.

Fuels: Fuels - Classification, examples, relative merits, types of coal, determination of calorific value of solid fuels, Bomb Calorimeter, theoretical oxygen requirement for combustion, Coal, Types of carbonization of coal, proximate & ultimate analysis of coal, manufacture of metallurgical coke, Petroleum, Cracking, Synthetic Petrol, Knocking, LPG, desulphurization of petrol.

Text Books:

1. Vermani, O.P. and A.K. Narula, *Applied Chemistry: Theory and Practice*. 2nd-Edition. New Age International Publishers, New Delhi, 2008.
2. Morrison, R.T. and R.N. Boyd, *Organic Chemistry*. 7th-Edition. Pearson Publisher, 2010.

Reference Books:

1. Jain and Jain, *Engineering Chemistry*. 15th-Edition. Dhanpat Rai & Sons, New Delhi, 2012.

2. Sharma, Deepa, *Textbook of Engineering Chemistry*. 1st-Edition. MedTech, Scientific International Pvt. Ltd., New Delhi, 2015.
3. Bahl, A. and B.S. Bahl, *Advanced Organic Chemistry*. Reprint. S. Chand & Company Ltd., New Delhi, 2012.

Course Code: SCL466
Course Name: QUANTUM CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Mathematical concepts: Vectors, Vector product, linearly dependant and independent vectors, linear vector space (introduction only) and basis set of LVS, Matrix, Types of Matrix (Symmetric, skew-symmetric, Hermitian, skew-Hermitian, unit, diagonal, unitary, etc) and their properties, Matrix equations, concept of eigen value and eigen vectors.

Quantum mechanics: Origin of Quantum mechanics, postulates of Quantum Mechanics, concepts of operators, Schrodinger equation, solution of the Schrodinger equation for simple systems viz. particle in a box, the harmonic oscillator, rigid rotor, the hydrogen atom, Born-Oppenheimer approximation. Variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate).Application of perturbation theory to the Helium atom. Concept of Angular momentum. Eigen value of angular momentum operator, method of ladder operator, spin. Slater determinant wave functions. Term symbol (R-S and j-j coupling) and spectroscopic states. Molecular orbital theory, LCAO principle, formation of molecular orbitals from atomic orbital, construction of molecular orbitals of H_2^+ by LCAO principle, physical picture of bonding and anti-bonding molecular orbitals, VB and MO theory. Huckel theory of conjugated systems, application to ethylene, butadiene, cyclopropenyl system, cyclobutadiene, etc.

Text Books:

1. Levine, I.N., *Quantum Chemistry*, 7th-Edition. PHI Learning Pvt. Ltd.,2014.
2. Szabo, A., and Neil S. Ostlund, *Modern Quantum Chemistry: Introduction to the Advanced Electronic Structure Theory*, Revised Edition. Dover Publications, Inc., 1996.

Reference Books:

1. McQuarrie, D.A. *Quantum Chemistry*, University Science Books, 2011.

Course Code: SCL467
Course Name: REAGENT CHEMISTRY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

1. Organolithium reagents: Use of lithium in organic synthesis: Lithium diisopropyl amide (LDA)
2. Organocupper regents: Use of Cupper in organic synthesis: Gilman's reagent
3. Organopalladium Chemistry: Use of Palladium in organic synthesis
4. Organosilicon Chemistry: Use of Siliconin organic synthesis: trimethylsilyliodide
5. Organotitanium Chemistry: Use of Titanium in organic synthesis: Tebbe's reagent
6. Organotin Chemistry: Use of Tin in organic synthesis: tri-n-butyl tin hydride
7. Organomagnesium Reagent: Use of Grignard reagents in organic synthesis
8. Oxidation reaction: Use of DDQ, Selenium dioxide, Osmium tetroxide in organic synthesis
9. Reduction Reaction: Use of complex metal hydrides, Wilkinson's catalyst, Lithium aluminium hydride (LAH), Sodium Borohydride, Di iso butyl aluminium hydride (DIBAL-H) etc.
10. Use of Baker's Yeast, Phase transfer catalyst, DCC etc. in organic synthesis.

Text Books:

1. Carruthers, W. and I. Coldham, *Modern Methods in Organic Synthesis*, 4th-Edition, Cambridge University Press, 2015.
2. March, J., *Advanced Organic Chemistry*, 4th-Edition. Wiley, 2007.

Reference Books:

1. Smith, M.B. and J. March, *March's Advanced Organic Chemistry: Reactions, Mechanisms and Structures*, Wiley, 2007.
2. Morrison, R.T. & R. N. Boyd, *Organic Chemistry*, 7th-Edition. Pearson Publisher, 2010.

Course Syllabi (Under Graduate)
Department of English

Course Code: HML151
Course Title: SOCIAL SCIENCE
Structure (L-T-P): 2-0-0
Prerequisite: NIL
Contents:
Introduction: Social Sciences, Relationship between an individual and society, Humanities and Social Sciences in Technology Institutes. Human civilization, History of science and Technology in India.
Society and Culture: What is society, Components of society. Culture, characteristics of culture, Ethnocentrism, Sub-culture and Assimilation
Industry and Society: Industrialisation in India, Industrial Policy Resolutions, Privatization, Liberalization and Globalization, Impact on Indian Society.
Group Behaviour, Group Properties (Roles, Norms, Status, Size and Cohesiveness) & Group Decision Making.
Motivation: What is Motivation, Early Theories & Classical Theories
Leadership: What is Leadership, Trait Theories, Behavioural Theories, Contingency Theories & Decision Theory
Study of Political Organization: Indian Constitution, Fundamental Rights, directive principals and RTI.
Main Social Problems in India: Corruption & Public Perception, Slums, Social JusticeMigration, Poverty, Violence, Rise of religious fundamentalism and Terrorism.
Text Books:
1. Elgin F. Hunt and David C. Colender, Social Science: An Introduction to the Study of Society, 13th edition Pearson Education, 2009.
2. Shabbir, S., Sheikh, A.M and Dwadashiwar, J., A New Look into Social Sciences, S. Chand and Company Ltd., 2012.
3. Ahuja, R., Social Problems in India, 2nd ed., Rawat Publications, 2013.

Reference Books:
1. Bhushan,V. and Sachdeva, D. R., Fundamentals of Sociology, Pearson Education, 2012.
2. Sirohi, A., Fundamentals of Sociology, 1st ed., Dominant Publishers, New Delhi, 2012.
3. Chandra, R., Globalisation, Liberalisation, Privatisation and Indian Polity (set of 8 Vols.), Isha Books, Delhi, 2004.
4. Ahuja, R., Indian Social System, Rawat Publications, Jaipur, 2009.
5. Baber, Zaheer. "Science, Technology and Colonial Power" in Social History of Science in Colonial India, edited by S. Irfan Habib & Dhruv Raina, Oxford University Press. pp.102-158, 2009.
6. Babbie, Earl. The Practice of Social Research, 10th Edition, Thomson, Singapore, 2006.
7. Giddens, Anthony and Sutton Philip, W. Sociology, 7th edition,Wiley: Delhi, 2013.
8. Haralambos,M. and Heald, R.M., Sociology-Themes and Perspective, Oxford University Press, New Delhi, 2008.
9. Kaur, Ravinder. "Locating the Humanities and the Social Sciences in Institutes of Technology" Sociological Bulletin, Volume 54, Number 3, pp. 412-427, 2005.
10. Ritzer, George."The McDonaldization of Society" in Sociological Odyssey: Contemporary Readings in Sociology, Edited by Patricia A. Adler and Peter Adler, Belmont: Wadsworth, pp. 371-379, 2001.
11. Srinivas, M. N. Social Change in Modern India, Orient Blackswan, New Delhi, 2007.

Course Code: HML152
Course Title: PRINCIPLES OF INDUSTRIAL MANAGEMENT AND PSYCHOLOGY
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Industrial Management, Scope and relevance, allied disciplines, Psychology, Industrial Psychology, Basic concepts Psychology, Learning, Perception and Motivation. Causes of Behaviour, Individual differences, Intelligence and Personality,
Industrial Sociology and Management, Evolution of Management thought, Principles of Industrial Management, Planning, Co-ordination and Communication, Types of Communication.
Personnel and Human Resource Management, Fundamentals of Marketing Management, Consumer Behaviour and advertising, Materials Management, ABC Analysis, ISO 9000 and ISO 14000.
Theories of Motivation, Maslow, Alderfer, Herzberg and Norms theory of Motivation, Leadership in Industry, Nature and Types, Theories of Leadership.
Conflict and Negotiation, Conflict Management. Fatigue in Industry. Work stress. Nature and sources of stress, Individual difference, coping strategies, Employee counselling. Quality of work life.
Text Books:
1. Kaila, H.L. *Industrial and Organisational Psychology* (2 vols.), Kalpaz Publications, Delhi, 2006.
2. Talwar, P. *Human Resource Management*, Isha Books, Delhi, 2006.

Reference Books:
1. Mittal, M.L., *Essentials of Educational Technology and Management*, Pearson Education, 2012.
2. Baron, R.A. and et.al., *Fundamentals of Social Psychology*, Pearson Education, 2012.
3. Srivastava, S.K. and Kumari, P., *Organisational Behaviour: A Comprehensive Study*, Global Vision Publishing House, 2009.

Course Code: HML153
Course Title: INDUSTRIAL PSYCHOLOGY AND HUMAN RESOURCE MANAGEMENT
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Industrial Psychology, Basic concepts of Psychology, Learning, Perception and Motivation. Causes of Behavior, Individual differences, Intelligence and Personality, History of Industrial Psychology in India.
Job analysis, Job design and Job appraisals.Selection and recruitment, Selection procedure, Selection Methods, Types of Selection Tests.Intelligence, Personality, Aptitude and Psycho-Motor Tests.Training, Types of Training, Job Satisfaction.
Foundation of Group Behaviour, Work Team Morale, Motivation, Importance and Nature, Theories of Motivation, Maslow, Alderfer, Herzberg and Norms theory of Motivation, Leadership in industry, Nature and Types, Theories of Leadership.
Conflict and Negotiation, Conflict Management. Fatigue in Industry. Work stress. Nature and sources of stress, Individual differences, coping strategies, Employee counseling. Quality of work life.
Human Resource Management. Participation in Decision making. Collective bargaining. Trade Union Movement in India. MBO and Quality Circle Movement, Wage and Salary Administration.H.R.M.in Asia, Europe and U.SA.
Text Books:
1. Pandey, A., *Psychology and Industrial Efficiency*, Global Vision Publishing House, New Delhi, 2006.
2. Baer, R., *Stress Management*, Global Vision Publishing House, New Delhi, 2010.

Course Code: HML154
Course Title: INDUSTRIAL ECONOMICS

Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Industrial Economics its scope and utility Economics systems: Capitalist, Communist and mixed economy. Land system and agriculture, taxes, money and credit, trade and exchange rate. Population, size composition, quality and growth trend, occupational distribution. Division of Economy into private and public sector Role of public sector in Indian economy.Privatization, Urbanization, Westernization, Modernization and Globalization. Scope and significance of productivity, Measurement of productivity, Tools of productivity, Factors influencing on industrial productivity, National productivity council. Globalization India and WTO. Trade policy of government of India, Import and Export Policy, New trade policy IMF, World Bank and associates Economic planning in India, Employment and economics.
Text Books:
1. Mishra, R.C. and Pandey, R.S., *Fundamentals of Financial Management*, Global Vision Publishing House, 2010.
2. Chaudhary, M.A., *History of International Trade and Monitory Economy*, Global Vision Publishing House, 2008.

Reference Books:
1. Sivayya, K.V. and Das, V.B.M., *Indian Industrial Economy*, 5th rev. ed., S. Chand and Company, 1983.
2. Mishra, S.K. and Puri, V.K., *Indian Economy: Its Development Experience*, 29th rev. ed., Himalaya Publishing House, Mumbai, 2011.
3. Dutta, R. and Sundaram, K.P.S., *Indian Economy*, S. Chand and Company, New Delhi, 2002.

Course Code: HML155
Course Title: INDUSTRY AND SOCIETY
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Factory as a social system Formal and informal organization.Impact of social structure on industry.Impact of industry on society.Changing profile of labour. Labour management Relation Participative Management Industrial Dispute and Trade unions, tripartite and Bipartite Body. Preventive and settlement machinery, Industrial health and safety Impact of Industrialization on family, education, and stratification. Class and class conflict in industrial sector obstacles and limitation of industrialization. Migration of work force
Types of Productive Systems: Guild System of Production, Factory system of Production, Putting-Out system of Production, Industrialisation and Daniel Bell's Model of Post Industrial Society
Organisational Theories: Max Weber's Model of Bureaucracy, Classical Management Principles, F.W.Taylor's Principle of Scientific Management, Human Relations Approach, Fordism and Japanese Organisational Structure
Recent Trends in Work and Industry: IT Industry in India, McDonaldisation of Society, Future of Work Social Exclusion in Indian MNCs
Text Books:
1. Moore, F., *Environment and Society*, 1st ed., Dominant Publishers and Distributors, New Delhi, 2003.
2. Sen, S., *Human Rights in a Developing Society*, APH Publishing Corporation, 2011.

Reference Books:
1. Khanna, O.P., *Industrial Engineering and Management*, 7th ed., Dhanapat Rai and Sons, 1985.
2. Bhagoliwal, T.N, *Economics of Labour and Industrial Relations*, 5th ed., Sahitya Bhawan, 1982.
3. Murthy, C.S.V, *Business and Ethics*, APH Publishing House, New Delhi, 2003.
4. Bhowmik, S., *Industry, Labour and Society*, Orient Blackswan, New Delhi, 2012.
5. Balakrishnan, Pulapre. (2006)"Benign Neglect or Strategic Intent? Contested Lineage of Indian Software Industry" Volume XLI, Number 36, *Economic and Political Weekly*, pp: 3865-3872.
6. Bell, Daniel. " Welcome to the Post-Industrial Society" *Physics Today*, Volume 29, Number 2, pp.46-49, 1976.
7. Bhoumik, Sharit, K. "The Working-Class Movement in India: Trade Unions and the State" in *People's Rights: Social Movements and the State in the Third World*, Eds. Manorajan Mohanty , Partha Nath Mukherji and OlleTornquist, New Delhi: Sage.pp.311-334,1998.
8. Giddens, Anthony and Sutton Philip, W. *Sociology*, 7th edition, Wiley: Delhi, 2013.
9. Jodhka, S. Surinder and Newman, Katherine. "In the Name of Globalisation Meritocracy, Productivity and Hidden Language of Caste" Volume XLII, Number 41, *Economic and Political Weekly*. pp: 4125-4132, 2007.
10. Ritzer, George. "The McDonaldization of Society" in *Sociological Odyssey: Contemporary Readings in Sociology*, Edited by Patricia A. Adler and Peter Adler, Belmont: Wadsworth, pp. 371-379, 2001.
11. Ritzer, George. *The McDonaldization of Society*, 6th edition. Thousand Oaks: Pine Forge,2011.
12. Schneider, Eugene.V. "Types of Productive Systems" in *Industrial Sociology: The Social Relations of Industry and the Community*, Chapter 3, New York: McGraw-Hill.pp.32-53,1969.
13. Thorat, Sukhadeo and Attewell, Paul. "The Legacy of Social exclusion: A Correspondence Study of Job Discrimination in India" Volume XLII, Number 41, *Economic and Political Weekly*. pp:4141-4145, 2007.
14. Weber, Max. "Characteristics of Bureaucracy" in *Readings in Industrial Sociology*, Edited by William A. Faunce, Chapter 6, New York: ACC, pp.133-135, 1967.

Course Code: HML156
Course Title: PERSONNEL MANAGEMENT AND INDUSTRIAL RELATION
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:
Human behaviour of an individual as a member as a small group and as a member of an organization, Influence of organizational culture on individuals.
Analysis of dynamic behaviour of organization by simulation structure of organization and flow of men, money, material, information capital, equipment and order, system models on the basis of policy of management to evolve effective policies for management.
Scope and objectives of personnel management, personnel planning, labour market, Job design,recruitment and selection, training and placement.
Job evaluation, merit rating wage incentives, employee health, security and welfare, morale and motivation, industrial disputes, voluntary and compulsory settlement machinery.
Labour legislations, Performance appraisal and evaluation
Text Books:
1. Sharma, A., *Management and Job Performance*, Gyan Publication House, 1986.
2. Mathur, K.M., *Managing Human Resource Development: An Indian Perspective*, Gyan Publication House, 2001.

Reference Books:
1. Knouse, S.B., *Human Resources Management Perspectives on TQM:Concepts and Practices*, ASQC Quality Press, 1996.
2. Schuler, R.S., *Managing Human Resources*, 6th ed., South-Western College Publishing, 1998.
3. Mamoria, C.B., Mamoria, S. and Gankar, S.V., *Dynamics of Industrial Relations*, Himalaya Publishing House, New Delhi, 2008.

Course Code: HMP151
Course Title: PREPARATORY ENGLISH
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Objective: To enhance the linguistic competence of the weaker section of the students.

Contents:

1. Understanding of spoken and written English
2. Writing simple sentence

Practical Exercises:

1. Sentence: Structure, Types of Sentences
2. Parts of Speech
3. Tenses & Voice
4. Paragraph Construction
5. Reading and Listening Comprehension

Text Books:

1. Wren and Martin. *English Grammar and Composition*. New Delhi: S. Chand, 2012.

Reference Book:

1. Sinha, R.P. Current English Grammar and Usage with Composition. Delhi: OUP, 2001.

Course Code: HMP152

Course Title: Technical Communication

Structure (L-T-P): 2-0-2

Prerequisite: NIL

Contents:

Objective: The primary objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for academic and social needs.

Unit-I Communication Fundamentals: Analysing Communication; Technical Communication: objectives and definitions; Information and Communications technology (ICT) in organizations; Levels of Communication, Barriers to Communication, Communication in Professional Context, and Importance of Effective Communication.

Unit-II Listening Skills: Kinds of Listening, Hearing and Listening, Barriers in Listening, Enhancing Listening Skills.

Speaking Skills: Art of Speaking, Stages of Speaking, Speech Style and Techniques, Types- Extempore, impromptu, debate.

Reading Skills: Introduction of different kinds of reading materials: technical & non-technical; Reading Comprehension: Effective Reading Skills, Reading Strategies, Textual Reading of Essays—(i) CEM Joad's "A Dialogue on Civilization"; (ii) A G Gardiner's "On Saying Please"

Writing Skills: Effective writing practice; brevity & clarity in writing – Cohesion & coherence in writing; Report Writing, Proposals, Writing Minutes, Professional Correspondences-Letter Writing, Job Application Letter, Résumé and CV.

Unit-III Speech Mechanism: Focus on organs of Speech, Sound and Speech, Vowels and Consonants, Diphthongs, Speech Process

Phonetics; Phonology, Phonemes, Stress, Rhythm, Intonation, Morphemes, Register, Style, Cluster, Variety in English; Places and Manners of Articulations.

Developing Speaking Skills: Instructions, Face to Face Communication, Meetings, Public Speaking, Group Discussion, Team Talk, Presentations, Seminars, Conferences, Interviews Techniques, and Mock Interviews, Conversation Practice Based on Audio and Visual Aids, Dialogues Delivery, Speech and Debate, Speaking on a given topic, Extempore, Words Exercise and Words Games to enhance Self-Expression, Pronunciation Practices.

Unit-IV Remedial Grammar: Parts of Speech, Determiners, Modals, Tenses-Verb Agreement, Active and Passive Voice, Direct and Indirect Speech, Transformation of Sentences, Sentence Structure, Finding Common Errors.

Vocabulary Building: Synonyms, Antonyms, One Word Substitutions, Word Formations, Idioms and Phrases, Homophones, Prefix, Suffix and Vocabulary Usage, Spelling.

Text Books:

1. Bansal, R. K. and J B Harrison. *Spoken English: A Manual of Speech and Phonetics*. Orient BlackSwan, 2013.
2. Green, David. *Contemporary English Grammar Structures and Composition*. Macmillan Publishers India Limited, 2013.
3. Sharma, Sangeeta and Binod Mishra. *Communication Skills for Engineers and Scientists*. Prentice-Hall of India Pvt.Ltd, 2009, Sixth Reprint 2015
4. Kumar, Sanjay & Pushp Lata. *Communication Skills*. New Delhi: OUP, 2016.

Reference Books:

1. Allen, W.S. *Living English Speech*. Orient Longman, 1984.
2. Wallace, H.R. and Masters, L.A. *Personality Development for Work*. South-Western Educational Publication, 1996.
3. Carnegie, D. and Napoleon Hill. *Public Speaking & Pleasing Personality*. BN Publishing, 2006.
4. *Balasubramanian, T. A Textbook of English Phonetics for Indian Students*. MacMillan, 2000.
5. Mohan, Krishna and Meera Banerji. *Developing Communication Skills*. MacMillan, 2013.

Course Code: HMP153

Course Title: URBAN SOCIOLOGY

Structure (L-T-P): 0-1-0

Pre-requisite: NIL

Contents:

Introduction to Urban Sociology: Origin, Nature and scope, Relevance of the study of Urban Sociology

Basic concepts: The City, Urbanization, Urbanism, Urbanity, Suburb, Metropolitan

Theories of Urban Sociology:

(a) Classical sociological traditions as urban and city dimensions, Emile Durkheim, Karl Marx, Max Weber and Ferdinand Tonnies
(b) Urban community and spatial dimensions. Park, McKenzie
(c) George Simmel: Metropolis, Louis Wirth: Urbanism as a Way of Life and Redfield: Rural Urban Continuum.
(d) Concentric Zone Theory and Sector Theory.
(e) Richard Florida-The Creative Class

Process of Urbanization in India: Growth of Urban Population in India, Emergence of Cities, Causes and Consequences of Urbanization

Urban Social Structure: Urban family, urban social stratification – Caste and Class, Occupational Divisions.

Urban Slums: Problems and challenges, urban development programmes.

Urban Planning: Meaning and Principles of Urban Planning, Urban Policy in India.

Text Book:

1. Patel, Sujata and Kushal Deb. *Urban Studies.* New Delhi: Oxford University Press, 2006.

Reference Books:

1. Sharma, Rajendra. *Urban Sociology.* New Delhi: Atlantic Publishers, 2010.
2. Ronnan, Paddison. *Handbook of Urban Studies*. New Delhi: Sage, 2000.

Course Code: HML351

Course Title: INDUSTRIAL MANAGEMENT

Structure (L-T-P): 3-0-0

Prerequisite: NIL

Contents:

General/Operation Management: Principles of Management, Forms of Companies ,Direct and Indirect taxes, Introduction to Export-Import, GST(Goods and Service Tax).Basics of Operation Management, Total Quality Management, 6Sigma, JIT and Concepts of Supply Management. Case Studies in Operation management

Finance Management: Basic Accounts, Balance-Sheet and Profit &Loss Statement, Capital Structure, Working Capital Management,

Stock Market, Investment Management, Sources of Finance. Current Case Studies in Finance

Marketing Management: Basics of Marketing, Marketing Strategies, Sales and Distribution, Advertisement and Branding, Consumer Behaviour. Current Case Studies in Marketing

Human Resource Management: Concepts of HRM, Job Analysis & design, Job Description, Recruitment, Selection and Induction, Performance Appraisal, Training and Development. Case Studies in HRM

Text Books:

1. Philip Kotler and Kevin Lane Keller, *Marketing Management*, Pearson India Education, Pvt. Ltd., 2016.
2. Bedi, Kanishka , *Production and Operations Management*, Oxford University Press, 2018
3. Maheshwari, S. N, *Management Accounting and Financial Control*, Sultan Chand & Sons, 2015.

Reference Books:

1. Fischer, Cythia and James B Shaw, *Human Resource Management,* Houghton Mifflin Company, 1993.
2. Prasad, L. M. *Principles and Practices of Management*, Sultan Chand & Sons, 2015.

Course Code: HML451
Course Title: SOCIAL DEMOGRAPHY
Structure (L-T-P): 3-0-0
Prerequisite: HML101
Contents:

Social Stratification and Change: Features of Stratification, Types of Stratification, Social Mobility, Vertical Social Mobility, Horizontal Social Mobility, Marxist, Weberian and Functionalist Perspectives on Stratification; Caste System; Sankritisation; Westernisation, Secularisation and Modernisation

Research Methods in Social Science: Ethnography**,** Case Study, Sampling, Survey Method, Experimental Method, Life History, Comparative Research, Historical Analysis, Human Subjects and Ethical Problems in Research.

Population Studies: Nature and Scope, Sources of Population Data, India's Population Policy, Growth and Distribution, Population Theories, Population Structure and Characteristics, Mortality, Fertility, Socio-Cultural Context of Fertility, Migration: The Concept of Migration, Emigration, immigrationand Assimilation, The Second Generation, Migration and Brain Drain, Remittance, Illegal Immigration, ,

Text Book:

1. Bhende, A. Asha and Kanikar Tara, *Principle of Population Studies*.
   Himalaya Publishing House, New Delhi, 2010.

Course Code: HML452
Course Title: ECONOMICS FOR ENGINEERS
Structure (L-T-P): 3-0-0
Prerequisite: NIL
Contents:

Introduction to principles of economics: Micro and macro, The economy: Its basic Problems and working system, Demand and Supply analysis, Elasticity of Demand and Supply: Price elasticity, Cross elasticity, Income elasticity, application of demand elasticity, elasticity and sales revenue, Theory of Consumer Demand- Cardinal and Ordinal approach, Consumer surplus. Analysis of Production and Cost: Theory of Production, Law of variable proportion, Marginal Rate of Technical substitution, Isoquant, Cost Analysis- Short run and Long run, Break even analysis. Market structure and Pricing of products: Pricing and Output determination under perfect competition, monopoly, monopolistic and oligopoly market.

Text Books:

1. Pindyck and Rubinfeld, Microeconomics, 7th edition, PHI, New Delhi, 2009.
2. Ahuja H.L., Business Economics, S Chand and Company publishers, 2008.

Reference Books:

1. Gupta G. S., Managerial Economics, 2nd edition, Tata Mcgraw-Hill, New Delhi, 2011.
2. Dwivedi D.N., Microeconomics: Theory and Applications, 2nd edition, Dorling Kindersley (India) Pvt. Ltd., 2012.
3. Peterson. H. C. and Lewis W. C., Managerial Economics, PHI, New Delhi, 4th edition, 2006..

Course Code: HML 453
Course Title: STUDIES IN CONTEMPORARY INDIAN ENGLISH LITERATURE
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Objective: to familiarize students with contemporary thought manifested in different genres of Indian English Writing and enable them to study and interpret such texts.

Contents:

Unit-1.GirishKarnad, *The Fire and the Rain*
Unit-2.Vikram Seth, "The Frog and the Nightingale", Amitav Ghosh: "The March of the Novel through History: The Testimony of My Grandfather's Bookcase" from *The Imam and the Indian*
Unit- 3.Kiran Desai: *The Inheritance of Loss*
Unit- 4.Mahesh Dattani, *Brief Candle: Three Plays*
Unit- 5.Arundhati Roy: *The God of Small Things*
Unit-6.Meenakshi Mukherjee: *The Twice Born Fiction: Themes and Techniques of the Indian Novel in English*

Text Books:

4. GirishKarnad. *The Fire and the Rain,* Oxford University Press, 2004.
5. Vikram Seth. *The Collected Poems*, Penguin India, 2000.
6. Amitav Ghos. *The Imam and the Indian,* Penguin India, 2010.
7. *Kiran Desai. The Inheritance of Loss, Penguin, 2014.*
8. Mahesh Dattani, *Brief Candle,* Penguin India, 2010.
9. Arundhati Roy: *The God of Small Things,*Penguin India, 1st edition, 2002.
10. Meenakshi Mukherjee: *The Twin Born Fiction: Themes and Techniques of the Indian* Novel in English. Heinemann, 1971.

Reference Books:

1. K.R.Srinivasa Iyenger. *Indian Writing in English*. Revised Edition, Sterling Publishers, 2012.
2. Arvind Krishna Mehrotra, ed. *Illustrated History of Indian Literature in English*. Orient Blackswan, 2005.
3. M.K. Naik. *Indian English Poetry: From the Beginnings upto 2000*.1 ed. Pencraft International, 2006.
4. *A History of Indian English Literature*. SahityaAkademi, 2009.

Course Code: HML454
Course Title: CREATIVE WRITING IN ENGLISH
Structure (L-T-P): 3-0-0
Prerequisite: NIL

Objective: To nurture writing skills for different forms of creative and professional writings.

Contents:

Introduction to Creative Writing: Creativity, Imagination and Resistance, Writer and the Text, Processes of Creative Writing and Its Development, Reading and the Individual Writer, Composition of Creative Writing; Creativity and Propaganda.

Art and Craft: Tropes and Figures, Varieties of English, Playing with Words, Grammar and Word Order, Tense and Time, Textual Reading

of Stephen Leacock's "On The Need For A Quiet College"; Francis Bacon's "Of Studies".

Fiction Writing: Writing Literary Fiction, Creative Non Fiction-History and Popular Fiction, Short Story and the Novel, Plot, Character, Modes of Narration, Setting, Literature of Reality Writing for Media: Print Media: Reportage, Feature Writing, Editorials, Columns, Textual Reading of Popular Columnists including M.J. Akbar, Tavleen Singh, Guru Charan Das and Shobha De.

The Broadcast Media: Radiobroadcast,

The New Media: Internet, Advertising: Writing and Sensitivity, Public Taste and Demand, Novelty of Ideas and Expression, Brevity and Focus, Verisimilitude,

Travel Writing: Reporting the World, Revealing the Self, Representing the Other, Elements of Style, Getting Published, Tools of the Art of Good Travel Writing, Finding and Focusing the Story, Crafting Structure, What it takes to be a Good Travel Writer

Studies of Masterpiece Scripts with screening of visual clips

Text Book:

1. Dev, Anjana Neira, Anuradha Marwah and Swati Pal. *Creative Writing: A Beginner's Manual.* New Delhi: Pearson & Longman, 2009.
2. Morley, David. *The Cambridge Introduction to Creative Writing*. New York: Cambridge University Press, 2007.

Reference Books:

1. Blair, Beth. *Break Into Travel Writing*. USA: McGraw-Hill, 2012
2. Forster, E.M. *Aspects of the Novel.* New Delhi: Atlantic Publishers, 1995.
3. Kaufman, Scott Berry and James C. Kaufman. *The Psychology of Creative Writing*. New York: Cambridge University Press, 2009.
4. *Lonely Planet's Guide to Travel Writing: Expert Advice from the World Leading Travel Publisher.* 3rd ed. Lonely Planet Publications, 2013.
5. Ramet, Adele. *Creative Writing*. 7th Edition. Begbroke: How to Books, 2007.

Course Code: HML455

Course Title: CORPORATE COMMUNICATION FOR TECHNOCRATS

Structure (L-T-P): 3-0-0

Prerequisite: NIL

Objective: To develop professional skills in students to prepare them for job opportunities. To facilitate them to meet the requirements of mushrooming corporate affairs.

Contents:

Corporate Communication in Theory:

Communication: What is Corporate Communication?: An Overview; Verbal and Non-verbal communication; Corporate Communication: Discipline or Job Description?; Barriers in Business Communication; Corporate Communication and Public Affairs; Leadership and Communication; Communication and Public Opinion; Corporate Communication Management; Advancements of Technical Communication in the Software Industry; Changing Business Environments; Communicating Strategically: Corporate Culture/Citizenship/Philanthropy/Social Responsibility; Negotiation Skills and Strategies.

Corporate Communication in Practice:

Comprehensions: Reading and Listening Comprehension, Expansion (Paragraph Writing), Note-making, Professional Letter Writing; Writing executive Summary; Research Writing: Articles for publication (Journals), dissertation, qualities of research writing and documentation; Styles of Business Writing.

Presentation: PPT Presentation, Group Presentation, Solo Presentation, Poster Presentation: Picture/Placard/Advertisement; Netiquette: Concept, components and evolution, etc. Reading and Analysing Text/s: Aravind Adiga: *The White Tiger*. Reading, reviewing, analysing and summarizing and paraphrasing. VAT: Video Apperception Test, Reviewing Video Clips/Movies, etc.

Text Books:

1. Kaul, Asha. *Business Communication*. New Delhi: Prentice Hall, 2000.
2. Sharma, Sangeeta and Binod Mishra. *Communication Skills for Engineers and Scientist*. 6th rprt. Delhi: PHI, 2009.

Reference Books:

1. Groves, William Bill. *Leadership Made Easy*. Speedy Publication, 2014.
2. Hartley, Peter and Clive Bruckmann. *Business Communication*. London & New York: Routledge, 2002.
3. Murphy, Herta, Herbert William Hildebrandt. *Effective Business Communication*. New York: McGraw Hill, 1991.
4. Mirel, Barbara. *Reshaping Technical Communication*. London: Lawrence Erlbaum, 2002.
5. Lesikar, Raymond V., John D. Pettit. *Business Communication*. McGraw-Hill, 1999.

Course Code: HML456

Course Title: SCREENWRITING AND DOCUMENTARY FILMMAKING Structure (L-T-P): 3-0-0

Prerequisite: NIL

Objective: To foster writing skills for screen and stage including the technicality of the vocation.

Contents:

Introduction to Screenwriting: What Is a Screenplay?, Screenplay Structure, Knowing the Subject, Creation of a Character, Building a Character, Story and Character, How to Begin, Know Your Ending, Setting Up the Story, Plot Points, Scene, Sequence, Building the Story Line, Screenplay Form, Screenplay-Terms, Writing the Screenplay, Adaptation and Collaboration, After It is Written, Editing

Introduction to Documentary Film Making: What is a Documentary?, Planning a Documentary, Idea and Script, Documentary Research, Documenting Behaviour, Visual Evidence, Conducting Interviews, Reality and Credibility and Ethics, Directing, Verisimilitude in Documentary, Location, Improvisation in Setting, Closing Thoughts on Cameras, Learning Camera Skills, Shots and Angles, Lighting and Set, Sound Effects and Sound Technicalities, Post Production Jobs, Editing

Screening of movies and documentaries: Study of docu-fiction and videos like "Children of the Pyre", "Gulabi Gang", "Seeds of Plenty Seeds of Sorrow," "Udaan," "Life of Pi," "The *Mistress of Spices,"* etc.

Text Book:

1. Field, Syd. *Screenplay: The Foundations of Screenwriting*. Newly Revised and Updated Edition. New York: Delta Trade, 2005.
2. Hampe, Barry. *Making Documentary Films and Videos: A Practical Guide to Planning, Filming, and Editing Documentaries.* 2nd Edition. New York: Henry Holt and Company, 2007.

Reference Books:

2. Holden, Tom. *Get Started in Filmmaking*. Teach Yourself Series. John Murray Learning. 2010.
3. Horton, Andrew and Julian Hoxter, eds. *Screenwriting*. New Brunswick and New Jersey: Rutgers University Press, 2014.
4. Mckee, Robert. *Story: Style, Structure, Substance and the Principles of Screenwriting*. Methuen Publishing Ltd., 1999.

Course Code: HML457

Course Title: INTERPRETING LITERATURE, THEATER AND CINEMA

Structure (L-T-P): 3-0-0

Prerequisite: NIL

Objective: To facilitate students to interpret multiple modes of literary and performative texts to hone their softs-skills. To sharpen their communication competence through various audio-visual toolkits.

Contents:

Introduction to literature and communication; Interpreting texts, Reading, writing and paraphrasing; Texts and its cinematic adaptations. Literary studies in India. Leadership Skills: reading & application: William Shakespeare's *Macbeth*, Jhumpa Lahiri's *The Namesake* (text and movie).

Introduction to theatre & personality development; Mime and one act play; Texts and its theatrical adaptations; Creative Writing; Interaction with public; Role play. Vijay Tendulkar's *Silence! The Court is in Session*, Girish Karnad's *Tuglaq*.

Introduction to cinema as a mode of communication; Character analysis; Youth, cinema and politics of communication; Interpreting commercial advertisements; Juvenile cinema and adolescent communication. Film studies in India. Crises Management: *3 Idiots*, *Guru*, *Manjhi: The Mountain Man*.

Practice sessions: PPT presentations; Enactment of plays; Reading novels, short stories; Reciting poems, public interactions.

Text Books:

1. Lahiri, Jhumpa. *The Namesake*. Mariner Books, 2004.
2. Karnad, Girish. *Tuglaq*. Delhi: OUP, 1997.
1. Shakespeare, William. *Macbeth*. Rupa, 2003.
2. Tendulkar, Vijay. *Silence! The Court is in Session*. Delhi: OUP, 2017.

Reference Books

1. Prasad, B. A Background to the Study of English Literature. Laxmi Publications, 2016.
2. Miller, Katherine. Communication Theories: Perspectives, Processes and Contexts. McGraw Hill, 2004.
3. Nellhaus, T. Theatre, Communication, Critical Realism (What is Theatre?). Palgrave Macmillan, 2010.
4. Sharma, Sangeeta, Binod Mishra. Communication Skills for Engineers and Scientists. Delhi: PHI, 2009.
5. Sell, Roger D. Literature as Communication: The Foundations of Mediating Criticism. John Benjamins Publishing, 2000.

Course Syllabi (Under Graduate)
Department of Mathematics

Course Code: SCL151
Course Title: PREPARATORY MATHEMATICS
Structure (L-T-P): 0-0-0
Pre-requisite: NIL
Contents:

Differential Calculus: Set theory, concept of functions, types of functions, limit, continuity, differentiability of functions, graphical representation of functions.

Integral Calculus: Basic concepts, Integration as a limit of sum, Elementary methods of integration (Integration by parts, by substitution and by partial fraction) Definite Integral basic rules, properties of definite integrals.

Geometry: Two dimensional geometry; straight lines, circle, conic sections. Three dimensional geometry; coordinate system, planes and straight lines.

Text Books:

1. Thomas, G.B. and Finney R.L., Calculus and Analytic Geometry, 9th ed., Addison-Wesley, 2003.
2. Loney, S.L., The Elements of Coordinate Geometry: Cartesian Coordinates Part-1, AITBS Publishers, India, 2014.

Course Code: SCL152
Course Title: APPLIED MATHEMATICS-I
Structure (L-T-P): 3-2-0
Prerequisite: NIL
Contents:

Differential Calculus: Limit, continuity and differentiability of functions of two variables, partial derivatives and their geometrical interpretation. Euler's theorem on homogeneous functions, Total differentiation, chain rules, Jacobian, Taylor's formula, maxima and minima, Lagrange's method of undetermined multipliers

Integral Calculus: Fundamental theorem of Integral calculus, mean value theorems, evaluation of definite integrals, Applications in Area, length, volumes and surface of solids of revolutions, Improper integrals: Beta and Gamma functions, Multiple Integrals: Double and triple integrals, change of order of integration, change of variables, application to area, volumes and C.G.

Vector Calculus: Scalar and vector fields, gradient of scalar point function, directional derivatives, divergence and curl of vector point function, solenoidal and irrotational vector fields.Vector integration: line, surface and volume integrals, Green's theorem, Stoke's theorem and Gauss divergence theorem (without proof)

Infinite series: Sequences, Infinite series of real and complex numbers, Cauchy criterion, tests of convergence, absolute and conditional convergence, uniform convergence, power series, radius of convergence.

Text Books:

1. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Narosa Publishers, 2014.
2. Thomas, G.B. and Finney R.L., Calculus and Analytic Geometry, 13th Edition, 2014.

Reference Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., Wiley-India, 2013.
2. Piskunov, N.S., Differential and Integral Calculus (Vol. 1 and Vol. 2), CBS Publishers and Distributors Pvt. Ltd., 2000
3. Greenberg, M.D., Advanced Engineering Mathematics, 2nd ed., Pearson Education, 2014.

Course Code: SCL153
Course Title: APPLIED MATHEMATICS-II
Structure (L-T-P): 3-2-0
Pre-requisite: NIL
Contents:

Matrices: Linear dependence and independence, Rank of matrix, consistency of a system of linear equations, Eigen values and Eigen vectors, Cayley – Hamilton theorem, reduction to diagonal form, Orthogonal matrices, Hermitian and skew Hermitian matrices, bilinear form, Quadratic forms.

Ordinary Differential Equations: Degree and order of differential equation, First order differential equations: Separation of variables and homogeneous, Exact equation, Integrating factors, Reducible to exact differential equations, Linear and Bernoulli's form, orthogonal trajectories, Picard's existence and uniqueness theorem (without proof), First order simultaneous differential equations. Second order linear ODE with Constant Coefficient, general solutions of homogeneous equations, Wronskian, reduction of order. Non-homogeneous equations: undetermined coefficients, variation of parameters, Euler-Cauchy equation, Series Solution of ODE, Frobenious Method, Bessel & Legendre equations and properties of their solutions.

Laplace Transforms: Definition of Laplace Transforms, condition for existence of Laplace Transform, Linearity property, first and second shifting properties, transforms of derivatives and integrals, evaluation of integrals by Laplace Transform. Inverse Laplace Transform,

Convolution Theorem, Laplace Transform of periodic functions, unit step function and Dirac delta function. Applications of Laplace Transform to solve second order ordinary differential equations.

Fourier Series: Periodic functions, Fourier series for interval length 2π, Fourier series for general interval, Fourier series for even and odd functions, half range sine and cosine series expansions, exponential form of Fourier series.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., Wiley-India, 2013.
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Narosa Publishers, 2014.

Reference Books:

1. Greenberg, M.D., Advanced Engineering Mathematics, 2nd ed., Pearson Education, 2014.
2. Boyce, W.E. and DiPrima, R.C. Elementary Differential Equations and Boundary Value Problems, 10th ed., John Wiley and Sons, 2013.

Course Code: SCL251
Course Title: APPLIED MATHEMATICS III
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Fourier Transforms: Fourier integral theorem, Fourier transform, Fourier Sine and Cosine Transforms, Linearity, Scaling, frequency shifting and time shifting properties, Convolution theorem.

Z-transform: Z-transform, Properties of Z-transforms, Convolution of two sequences, inverse Z-transform, Solution of Difference equations.

Numerical Methods Errors: absolute error, relative error, round off error, truncation error, Solutions of algebraic and transcendental equations: Bisection Method, Regula Falsi method, Secant Method, fixed point iteration method, Newton-Raphson method and convergence of these methods. Newton Raphson method for system of nonlinear equations and their convergence. Solution of algebraic system of linear equations: Gauss elimination, LU Decomposition, Jacobi and Gauss-Seidal iterative methods. Diagonally dominance and convergence, Solution of tridiagonal system. Interpolation, Newton's Divided Difference, Lagarange's Interpolation, Cubic Spline Interpolation. Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson's Rule, Composite Rule and their errors. Numerical Solutions of First Order Ordinary Differential Equations and Simultaneous Differential Equations (IVP): Taylor's Series Method, Euler's Method, Runge-Kutta Methods; FDM Approximations for Derivatives, BVP with Explicit Boundary Conditions, Implicit Boundary Conditions.

Complex Analysis: Functions of a complex variable: continuity, differentiability, CR-equations, analytic functions, entire functions, complex integration, Cauchy's integral theorem. Cauchy's integral formula, Pole and Residue, Cauchy's residue theorem, Taylor's series, Laurent's series, singularities, zeros of an analytic function, contour integration, the fundamental theorem of algebra. Conformal mapping, bilinear transformation, transformation by elementary functions.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., Wiley-India, 2013.
2. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, 6th ed., New Age International, 2012.

Reference Books:

1. Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, 7th ed., Pearson Education, 2009.
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Narosa Publishers, 2014.

Course Code: SCL253
Course Title: PROBABILITY AND NUMERICAL METHODS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Random Variable & Probability Distributions: Random Variable, Distribution Functions for Continuous and Discrete Random Variables. Some Special Probability Distributions Like Binomial, Poisson, Geometric, Normal, Uniform, Exponential and Gamma Distributions. Bivariate Random Variable and Distribution Functions for Continuous and Discrete Bivariate Random Variables. Mathematical Expectation, The Variance and Standard Deviation. Moment Generating Function, Characteristic Function. Random Processes, Continuous and Discrete, Deterministic, Stationary, Ergodicity Etc., Correlation Functions, Autocorrelation and Cross-Correlation, Properties and Applications of Correlation Functions.

Numerical Methods: Errors: Absolute Error, Relative Error, Round Off Error, Truncation Error, Solutions of Algebraic and Transcendental Equations: Bisection Method, Regula Falsi Method, Secant Method, Newton-Raphson Method and Convergence of these Methods. Newton Raphson Method for a System of Nonlinear Equations and their Convergence. Solution of Algebraic System of Linear Equations: Gauss Elimination, LU Decomposition, Jacobi and Gauss-Seidal Iterative Methods. Diagonally Dominance and Convergence, Solution of Tridiagonal System.

Interpolation, Newton's Divided Difference, Lagarange's Interpolation, Cubic Spline Interpolation. Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson's Rule, Composite Rule and their errors. Numerical Solutions of First Order Ordinary Differential Equations and Simultaneous Differential Equations(IVP): Taylor's Series Method, Euler's Method, Runge-Kutta Methods; FDM Approximations for Derivatives, BVP with Explicit Boundary Conditions, Implicit Boundary Conditions.

Text Books:

1. Papoulis, A., Probability, Random Variables and Stochastic Processes, 4th ed., McGraw Hill, 2012.
2. Ravichandran, J., Probability and Statistics for Engineers, Wiley-India Pvt. Ltd., Reprint Edition: 2015.
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, 6th ed., New Age International, 2012.

Reference Books:

1. Spiegel, M.R., Schiller, J.J. and Srinivasan, R.A., Probability and Statistics, 4th ed., McGraw Hill, 2013.
2. Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, 7th ed.,Pearson Education, 2009.
3. Atkinson, K.E., an Introduction to Numerical Analysis, 2nd ed., John Wiley and Sons, 2004.

Course Code: SCL254
Course Title: DISCRETE MATHEMATICS
Structure (L-T-P): 3-2-0
Pre-requisite: NIL
Contents:

Set theory, operations on sets-relation and functions, continuity, partial order, equivalence relations, Peano axioms and induction, recursive algorithms, program correctness, complexity of algorithms.

Mathematical logic, propositions, predicates and quantifiers, nested quantifiers, Rules of inference, Introduction to proofs, method of proofs.

Algebra, homomorphism automorphism, Elements of Theory of some algebras, semigroups, monoids, groups. Rings, fields, lattices, bolean Algebra

Graphs: Connectivity, Euler and Hamiltonian Paths, Shortest Path, Planar Graph, Graph Coloring, transitive closure

Trees: tree traversal, spanning trees, minimum spanning tree

Basics of Counting, The Pigeonhole principle, Combinatorics, generating functions, recurrences, Counting theorem and applications.

Text Books:

1. Kolman, B., Discrete Mathematical Structures, 6th ed., Pearson Education, 2014.
2. Garnier, R. and Tayor, J., Discrete Mathematics: Proofs, Structures and Applications, 3rd ed., Taylor and Francis, 2010.

Reference Books:

1. Rosen,Keeneth H, Discrete Mathematics and Its Applications, 7th Edition, McGraw Hills Publications, 2012.
2. Liu, C.L., Introduction to Combinatorial Mathematics, McGraw Hill, 1986.

Course Code: SCL452
Course Title: LINEAR ALGEBRA
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Matrices: Review of Matrix Algebra; Rank of matrix, Row reduced Echelon form, Solution of the matrix Equation $Ax = b$, Vector Space, Subspaces, Linear Dependence/Independence, Basis, Dimension, Range Space and Rank, Null Space and Nullity; Rank nullity theorem, Linear transformation, Matrix Representation of a linear transformation, Linear transformation on R^n and their representation as square matrices, Invertible linear operators, Inverse of a non-singular matrix, Eigen values and eigenvectors of a linear operator; properties of eigen values and eigen vectors of Hermitian, skew-Hermitian, Unitary, and Normal matrices (including symmetric, skew-symmetric, and orthogonal matrices), Characteristic Equation, Bounds on eigenvalues, Cayley Hamilton theorem, Diagonalizability of matrix.

Inner Product Spaces, Norm, Orthonormal Sets, Gram Schmidt orthogonalisation process; projections and least squares approximation.

Optimization: Modeling and formulation of optimization problems, Linear programming and Simplex Algorithm (Big M and Two Phase Method), Duality and the primal dual method.

Text Books:

1. Hoffman, K. and Kunze, R.A., Linear Algebra, 2nd ed., Pearson Education, 2012.
2. Bazaraa, M. S., Jarvis, J. J., & Sherali, H. D. (2011). Linear programming and network flows. John Wiley & Sons.

Reference Books:

1. Krishnamurthy, V., Mainra, V.P. and Arora, J.L., An Introduction to Linear Algebra, East-West Press, 1976.
2. Bhattacharya, P.B., Jain, S.K. and Nagpaul, S.R., First Course in Linear Algebra, New Age International Publishers, 2005.
3. Datta, K.B., Matrix and Linear Algebra, Prentice Hall of India, New Delhi, 2006.

Course Code: SCL453
Course Title: PROBABILITY THEORY AND STATISTICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Random Variable & Probability Distributions: Random Variables, Density function, distribution function for continuous and discrete R.V.Joint distributions, Distributions of functions of R.V. Mathematical Expectation, The variance and Standard deviation, Moment Generating Function, Characteristic Function. Some special probability distributions like Binomial, Poisson, Geometric, Normal, Uniform, Exponential Gamma Beta, Chi-Square, Students 't', F-distribution and Weibull Distribution.

Statistics: Sampling Theory: Population Parameter, Sample Statistics, Sampling distributions, Sample mean, Sampling distribution of means, The Sample variance, and the sampling distribution of variance.

Estimation Theory: Point estimate and Interval Estimates, Reliability, Confidence interval estimates of population parameters, confidence intervals for means, proportions and variance.

Tests of Hypothesis and Significance: Statistical decisions, Tests of hypothesis and significance. Type I and Type II errors. Level of significance, one tailed and two tailed tests. Tests involving small samples and large samples .Fitting theoretical distributions to sample frequency distribution .The chi-square test for goodness of fit.

Text Books:

1. Miller, I. and Miller, M., John E. Freund's Mathematical Statistics with Applications, 7th ed., Pearson Education, 2013.
2. Ravichandran, J., Probability and Statistics for Engineers, Wiley-India Pvt. Ltd., Reprint Edition: 2015.
3. Parzen, E., Modern Probability Theory and Its Applications, John Wiley and Sons, 2013.

Reference Book:

1. Spiegel, M.R., Schiller, J.J. and Srinivasan, R.A., Probability and Statistics, 4th ed., McGraw Hill, 2013.

Course Code: SCL454
Course Title: APPLIED SINGULAR INTEGRAL EQUATIONS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Introduction: Integral Equations, Basic Definitions, Singular Integral Equations, Weakly Singular Integral Equation(Able type), Cauchy Type Singular Integral Equations, Hyper singular Integral Equation.

Elementary Methods of Solution of Singular Integral Equations: Able's Integral Equation and its Generalization, Integral Equations with Logarithmic Type of Singularities, Integral Equations with Cauchy Type Kernels, Solution of Simple Hyper singular Integral Equations, Application to Boundary Value Problems in Elasticity.

Riemann-Hilbert Problems and Their Uses in Singular Integral Equations: Cauchy Principal Value Integrals, Solution of Singular Integral Equations Involving Closed Contours, Riemann-Hilbert Problems, Generalized Abel Integral Equations, Singular Integral Equations with Logarithmic Kernels.

Special Methods of Solution of Singular Integral Equations: Integral Equations with Logarithmically singular Kernels, Integral Equations with Cauchy Type Kernels, Use of Poincare-Bertrand Formula.

Numerical Methods for Singular Integral Equations: General Numerical Procedure for Cauchy Singular Integral Equation, Numerical Solution of Hyper singular Integral Equation using Simple Polynomial Expansion.

Text Books:

1. Mandal B.N. &Chakrabarti A.N., Applied Singular Integral Equation, CRC Press, Taylor & Francis, 2011.

Reference Books:

1. Dzhuraev A., Methods of Singular Integral Equation, Longman Scientific & Technical, John Wiley & Sons, 1992.
2. Jerry A.J., Introduction to Integral Equations with Applications (2nd Edition), John Wiley & Sons, 1999.

Course Code: SCL455
Course Title: FINITE ELEMENT METHOD STRUCTURE
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Mathematical Preliminaries, Integral Formulations, and Variational Methods: Weighted Residuals Methods- Galerkin's, Collocation and Least Square Methods. Variational Principles and Methods, Variational Formulations, Elements of Calculus of Variations, Integral Formulations, Variational Methods, Bilinear form and weak formulation,The Ritz Method, Equivalence of Ritz's and Galerkin's method for a self-adjoint differential equation.

Finite Element Models for Second-Order Differential Equations in One Dimension: Basic concepts of Second-Order Differential Equations in One Dimension, Basic Steps of Finite Element Analysis (Model Boundary Value Problem, Discretization of the Domain, Derivation of Element Equations, Connectivity of Elements, Imposition of Boundary Conditions, Solution of Equations and Post computation of the solution, Convergence Criteria, h and p Approximations), Applications of Second-Order Differential Equations in One Dimension to Discrete Systems/Heat Transfer/Fluid Mechanics/Solid and Structural Mechanics and Plane Trusses.

Finite Element Models for Boundary Value Problems in Two Dimensions: Introduction to Boundary Value Problems, The Model Equation, Finite Element Discretization, Weak Form, Finite Element Model, Derivation of Interpolation Functions, Evaluation of Element Matrices and Vectors, Assembly of Element Equations, Imposition of Boundary Conditions and Post computations, Natural Coordinates, Numerical Integration, Elemental Equations, Connectivity and Assembly, Applications to Conduction and Convection Heat Transfer.

Text Books:

1. J.N. Reddy, An Introduction to the Finite Element Method (3rd Edition), Tata McGraw-Hill Publishing Company Limited.

2. Cook, R. D., Malkus, M.E. P. and Witt, R.J., Concepts and Applications of Finite Element Analysis, John Wiley and Sons (2001).

Reference Books:

1. Bathe, K. J., Finite Element Procedures, Prentice Hall (2002).
2. Rao S. S., The Finite Element Method in Engineering (Fourth Edition), Butterworth-Heinemann (2005).
3. Bhatti M.A., Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations, John Wiley & Sons (2005).
4. Fish J. and Belytschko T., A First Course in Finite Elements, John Wiley & Sons (2007).
5. Zienkiewicz O.C., Taylor R. L. and Fox D.D., The Finite Element Method for Solid and Structural Mechanics, Seventh Edition, Butterworth-Heinemann (2013).

Course Code: SCL456
Course Title: FRACTURE MECHANICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Overview of Fracture Mechanics: Brief Overview of Theory of Elasticity, Historical Aspects of Fracture, Kinds of Failure, Brittle & Ductile Fracture, Modes of Fracture Failure.

Energy Release Rate: Introduction, Griffith's Dilemma, Realization and Analysis, Energy Release Rate: Definition, Mathematical Formulation, Change in Compliance & Strain Energy Approach, An elastic Deformation at Crack-tip, Crack Resistance, Stable & Unstable Crack Growth, R-curve for Brittle Cracks, Critical Energy Release Rate.

Stress Intensity Factor: Introduction, Stress & Displacement Fields in Isotropic Elastic Materials, Mathematical Analysis, Westergaard's Approach, Stress Intensity Factor (SIF) for Wedge Loads on Cracked Surfaces, Collinear cracks in an Infinitely Long Strip, Principle of Superposition, Edge cracks, Embedded cracks, Relation between Energy Release Rate & SIF, Critical SIF.

An elastic Deformation at the Crack Tip: Investigation at the crack-tip, Approximate Shape & Size of the Plastic Zone, Effective Crack Length, Irwin Plastic Zone Correction, Plastic Zone Size through the Dugdale's Approach, Effect of Plate Thickness, J-Integral, Numerical Evaluation of J-Integral, Crack-tip Opening Displacement.

Mixed Mode Crack Initiation & Growth: Introduction, Mixed Mode crack Propagation Criteria, Modified Griffith Criterion, Maximum Tangential Stress Criterion, Strain Energy Density Criterion, Crack Growth.

Finite Element Analysis of Cracks in Solids: Finite Element Method, Direct Methods to Determine Fracture Parameters, Indirect Methods to Determine Fracture Parameters as J-Integral, Energy Release Rate, Stiffness Derivative, Singular Element &Barsoum Element Method.

Text Books:

1. Kumar Prashant, Elements of Fracture Mechanics, Tata McGraw-Hill Education Private Limited, 2009.
2. Broek D., Elementary Engineering Fracture Mechanic, Kluwer Academic Publishers, Dordrecht, 1986.

Reference Books:

1. Anderson T. L., Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.
2. Gdoutos E. E., Fracture Mechanics: An Introduction (Solid Mechanics and Its Applications), 2nd Edition, Springer Publications, 2005.

Course Code: SCL462
Course Title: NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Variational Methods: Variational Principles and Methods, Variational Formulations, Elements of Calculus of Variations, Integral Formulations, Variational Methods (The Ritz Method, Approximation Functions and the Method of Weighted Residuals).

Finite Element Method for Differential Equations in One Dimension:Basic concepts of Second-Order Differential Equations in One Dimension, Basic Steps of Finite Element Analysis (Model Boundary Value Problem, Discretization of the Domain, Derivation of Element Equations, Connectivity of Elements, Imposition of Boundary Conditions, Solution of Equations and Post-computation of the solution, Convergence Criteria, h and p Approximations), Applications of FEM for Solving Second-order Differential Equations in One Dimension.

Finite Difference Method for Solving Partial Differential Equations: Introduction to partial differential equations, Finite Difference Method for Solving One Dimensional Parabolic Differential Equations (explicit, fully implicit, C-N scheme), Discussion of Convergence, Stability and Compatibility, Finite Difference Methods for Elliptic Partial Differential Equations (Standard five point formula and Diagonal five point formula).

Text Book:

1. Kreyszig, E. Advanced Engineering Mathematics. 9th-Edition. Wiley India Edition, 2013.
2. Reddy, J.N. An Introduction to the Finite Element Method. 18th Reprint-2013. Tata McGraw-Hill Publishing Company Limited, 2006.

Reference Books:

1. Bathe, K. J. Finite Element Procedures. 7th Indian Reprint. Prentice Hall, 2003.
2. Cook, R. D., M.E. P. Malkus and R.J. Witt. Concepts and Applications of Finite Element Analysis. 4th-Edition. Reprint-2102. John Wiley and Sons, 2004.
3. Fish, J. and T. Belytschko. A First Course in Finite Elements. John Wiley & Sons, 2007.
4. Gerald, C.F. and P.O. Wheatley. Applied Numerical Analysis. 6th Edition. Wesley, 2002.
5. Reddy, J.N. Applied Functional Analysis and Variational Methods in Engineering. McGraw-Hill, 1986.
6. Smith, G.D. Numerical Solution of Partial Differential Equations. 3rd-Edition. Oxford University Press, 1985

Course Code: SCL463
Course Title: INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

First Order PDEs: Introduction & Formation of PDE's,First order PDE: Classification of first order PDEs; Complete integral, General integral, singular integral; Solutions of linear first order PDEs: Lagrange's Method; First order Non-linear partial differential equation, Method of characteristic Compatible systems; Charpit's method, special types of first order equations, Jacobi's Method for nonlinear first order equations.

Second Order PDEs: Classification of second order PDEs; Canonical forms for Hyperbolic, Parabolic & Elliptic PDEs; Method of characteristics; Initial and Boundary value problems (Dirichlet and Neumann type) involving wave equation, heat equation, Laplace's equations (solutions by method of separation of variables and Fourier Transform).

Text Book:

1. Rao, K. S. Introduction to Partial Differential Equations. 3rd – Edition. PHI Learning Pvt.Ltd. ,2011.
2. Snnedon, I.N. Elements of Partial Differential Equations. Dover Publications, 2006

Reference Books:

1. Jain, R.K. and S.R.K. Iyengar. Advanced Engineering Mathematics. 4th –Edition. Narosa Publisher, 2014.
2. Kreyszig, E. Advanced Engineering Mathematics. 9th -Edition. John Wiley & Sons, 2013.
3. Strauss, W.A. Partial Differential Equations: An Introduction. 2nd – Edition. John Wiley & Sons Publisher, 2008.

Course Code: SCL465
Course Title: CONVEX OPTIMIZATION
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Introduction: Basic definition, problem formulation and illustrative examples. Miscellaneous Application and Model Construction. Convex Analysis: convex sets, closest point theorem, existence of minimum, Weierstrass's Theorem, Separation and Support Sets, Convex Cones, Extreme Points and Extreme Directions, Theorem of alternatives, Farka's lemma, Gordan's theorem, convex functions, minima and maxima of convex functions, generalizations. Necessary conditions for unconstrained nonlinear minimization, Sufficient conditions for unconstrained nonlinear minimization. Linear programming: Motivation, formulation, optimality conditions, simplex method, duality theory: weak and strong duality theorem, dual simplex method. Constrained optimization: role and definition of constraints, Fritz John optimality conditions, KKT optimality conditions. Quadratic Programming,; interior-point methods; Case studies: signal processing, statistics and machine learning, control and mechanical engineering, digital and analog circuit design, and finance.

Text Books:

1. Bazaraa, M. S., Hanif D. Sherali, and Chitharanjan M. Shetty. Nonlinear programming: theory and algorithms, 3rd-Edition. John Wiley & Sons, 2013.
2. Rao, Singiresu S., and S. S. Rao. Engineering optimization: theory and practice, 4th-Edition. John Wiley & Sons, 2009.

Reference Books:

1. Fletcher R. Practical Methods of Optimization, 2nd Edition. John Wiley, 2009.
2. Belegundu, A. D., and Tirupathi R. Chandrupatla. Optimization concepts and applications in engineering. 2nd-Edition. Cambridge University Press, 2011.
3. Boyd, Stephen, and LievenVandenberghe. Convex optimization. 1st-Edition. Cambridge University Press, 2004.
4. Mohan, C., and K. Deep. Optimization techniques. 1st-Edition, New Age Science, 2009.

Course syllabi (Under Graduate)
Department of Physics

Course Code: SCL154
Course Title: APPLIED PHYSICS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Quantum mechanics: Wave nature of a particle, Planck's quantum hypothesis, Black body radiation, Photoelectric effect, X-ray production, Compton effect, Davisson Germer experiment, De-Broglie concept, Heisenberg Uncertainty Principle. Physical significance of Wave function, Probability density, Expectation value, Eigen value equation, Operators, Postulates of Quantum theory, Schrödinger wave equation: Time dependent & Time independent, Particle in 1-D Box, 1-D Harmonic Oscillator, Boundary Conditions, k-space, Density of states 1D, 2D, 3D systems, Fermi Dirac distribution, Electron energies, Fermi surface for the free electrons.

Electromagnetics: Maxwell's Electromagnetic equations, Electromagnetic waves, Poynting vectors, Cyclotron.

Optics: Interference, Young's Interference, Thin films interference, Diffraction, Diffraction of gratings, Dispersion, Resolving power, X-ray diffraction, Polarisation, Introduction to Lasers, Fibre Laser, Ruby Laser, He-Ne Laser, Semiconductor laser, Optical fiber, Transmission of light through fibers.

Solid state physics: Atomic potentials, Molecules, Solids, Energy Bands, Types of solids, Crystal structures: The basis and crystal structure, Atomic packaging: Simple Cubic Structure, Body Centred Cubic, Face Centred, Hexagonal Close Packed Structure, Miller indices, Band theory, Band density of states, Bloch function, Fermi surface of Solids, Electrical conductivity, Semiconductors, Intrinsic Semiconductors, p and n-type semiconductors, Hall effect, p-n junction diodes, Drift current and diffusion current.

Text Books:
1. Beiser, A., Concepts of Modern Physics, 6th Ed., Tata McGraw Hill, 2009.
2. Ghatak A. K., Optics, 5th Ed., Tata McGraw Hill Education, New Delhi, 2012.

Reference Books:
1. Halliday, D., Resnick R. and Walker, J., Principles of Physics, 9th Ed., Wiley India, 2013.
2. Krane Keneth S, Modern Physics, Wiley, 3rd Ed., 2012.
3. Pillai, S.O., Solid State Physics, 6th ed., New Age International, New Delhi, 2010.
4. Dommelen, L.V., Quantum Mechanics for Engineers, Dommelen, 2004.
5. Jenkins, F.A. and White, H.E., Fundamentals of Optics, 4th Ed., Tata McGraw Hill, 2001.
6. Ghatak, A.K. and Thyagarajan, K., Fiber Optics and Lasers: The Two Revolutions, Macmillan India Ltd., 2006.
7. Eisberg, R. and Resnick, R., Quantum Physics, 2nd Edition, Wiley, 2006.

Course Code: SCL252
Course Title: ELECTRONIC AND ELECTROMAGNETIC MATERIALS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Contents:

Electrical Conduction: Electrical conductivity, resistivity of materials and their applications, Effect of temperature and impurity on conductivity, Conductivity of pure metals and alloys, Mechanical effect on electrical resistance, Conductivity at high frequencies, Joules law, Temperature coefficient of resistivity, Heating element, Fixed and variable resistor.

Lasers: Basic concepts of Lasers, Different types of laser and their applications.

Optical Fiber: Introduction to optical fiber, Types of optical fiber, Attenuation and transmission in optical fibre, Manufacturing and their applications.

Polarization of Dielectrics: Polar and non-polar dielectrics, Basic concept of polarization, Types of polarization, Dielectric constant, Internal field in dielectrics, Ferroelectric, Spontaneous polarization, Curie-Weiss law, Piezoelectric and Pyroelectric, Dielectric loss, Breakdown in dielectrics. Ceramic, dielectrics used in cables and transformers.

Magnetic Properties of Materials: Atomic interpretation of diamagnetic, Paramagnetic, anti-ferromagnetic and ferromagnetic materials, Ferromagnetic domain, permanent magnets and non-magnetic steels, nonmetallic magnetic materials, ferrites, Applications of Magnetic materials in ferromagnetic tapes and memory devices, Superconductivity and applications.

Text Books:
1. Pillai, S. O., Solid State Physics, 6th Ed., New Age International, New Delhi, 2010.
2. Dekker, A. J., Electrical Engineering Materials, Prentice Hall of India, New Delhi, 2013.

Reference Books:
1. Krane, K. S., Modern Physics, 3rd Ed., John Wiley, 2012.
2. Omar, M.A., Elementary Solid State Physics: Principles and Applications, 4th Ed., Pearson Education, 2008.
3. Kasap, S. O., Principles of Electronic Materials and Devices, 3rd Ed., Tata McGraw Hill, 2007.
4. Balasubramaniam, R., Callister's Materials Science and Engineering, Wiley India, 2009.
5. Puri, R.K. and Babbar, V.K., Solid State Physics and Electronics, S. Chand Limited, 2008.
6. Kittel, C., Introduction to Solid State Physics, 8th Ed., Wiley India, 2008.

Course Code: SCL351
Course Title: INTRODUCTION TO MATERIAL SCIENCE
Structure (L-T-P): 3-0-0
Pre-requisite: SCL154
Contents:

Crystalline structures, Imperfection in solids: Point defects, Thermodynamics of point defects. Dislocations, Grain Boundaries, Low and high angle grain boundaries. Heat Treatment, Diffusion Mechanisms: Steady and non-steady state diffusion, Factors influencing diffusion. Thermal Behaviour, Phase Diagrams: Unary phase diagram, Gibbs Phase Rule, Binary Isomorphous Systems, Lever Rule, Interpretation of phase diagrams, Determination of phase amounts, Equilibrium and non-equilibrium solidification, Phase Transformations: Kinetics of phase transformations, Homogeneous and heterogeneous nucleation, Kinetic considerations of solid-state transformations. Structural Materials: Nanomaterials, Metals, Non-metals, Ceramics and Glasses, Polymers composites. Optical and Magnetic properties of materials.

Text Books:
1. Raghwan, V., Material Science and Engeenearing, Prentice Hall, India, 5th Ed., 2007.
2. Callister, W. D., Fundamentals of Materials Science and Engineering, Wiley, 2007.

Reference Books:
1. R. Balasubramaniam, Callister's Materials Science and Engineering, Wiley, 2013.
2. Pillai, S.O., Solid State Physics, 6th Ed., New Age International, New Delhi, 2010
3. Kittle, C., Introduction to Solid State Physics, Wiley, 2007.
4. Rohrer, Structure and Bonding in Crystalline Materials, Cambridge University Press, 2001.
5. Hassen, P., Material Science and Technology, Volume 5, Phase Transformation in Materials.

Course Code: SCL352

Course Title: GREEN ENERGY AND APPLICATIONS
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Course objective: To understand the importance of Green energy resources, its utilization for mankind applications and also the environmental impact of these resources.
Contents:
Introduction: Green energy scenario, Potentials, Economics and Reserves of Energy Resources.
Wind Energy: Fundamentals of wind energy, Wind energy estimation, Types of wind energy systems, Safety, Environmental impact and Applications. **Hydro Energy:** Hydropower resources, Types of hydro energy systems, Importance, Environmental impact and Applications. **Solar Energy:** Fundamentals of solar energy, Solar radiations, Importance, Measurement and Storage, Solar Cell, Types of solar energy systems, Environmental impact and Applications. **Geothermal Energy:** Geothermal resources, Small hydro-geothermal energy, Environmental impact and Applications. **Ocean Energy:** Principles of ocean energy, Tide characteristics and statistics, Ocean thermal energy, Ocean Bio-mass, Environmental impact and Applications. **Nuclear Energy:** Nuclear reactor physics, Radiation protection, Safety of nuclear power plants, Waste management, Energy transformations, Materials in nuclear engineering, Nuclear fuel cycle, Environmental impact and Applications. **Fossil fuels and Alternate Sources of energy:** Fossil fuels, Hydrogen and Storage, Hybrid Systems, limitations, Tidal Energy, Wave energy systems, Biomass, Biochemical conversion, Environmental impact and Applications.
Text Books:
1. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, 3rd edition, Oxford University Press and Open University, 2012.
2. Non-conventional energy sources, B.H. Khan, McGraw Hill, 2006.

Reference Books:
1. J. W. Twidell, A. Weir, Renewable Energy Sources, EFN Spon. Ltd., UK, 2006.
2. Bent Sqrensen, Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning, Academic Press, 4th edition, 2011.
3. S. P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. L. L. Freris, Wind Energy Conversion Systems, Prentice Hall, UK, 1990.
5. L. Johnson Gary, Wind Energy Systems, Prentice Hall, New York, 1985
6. David M. Mousdale, Introduction to Biofuels, CRC Press, Taylor & Francis Group, USA 2010.

Course Code: SCL353
Course Title: ADVANCED MATERIALS AND DEVICES
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Course Objectives: To introduce the students with the modern materials, their properties, applications and associated phenomena
Contents:
Material types and their importance as devices, Basics of magnetism, magnetic materials, direct and indirect exchange interactions, surface and confinement effects, magnetic multilayers, giant magneto-resistance, tunneling magneto-resistance and colossal magneto-resistance (GMR, TMR and CMR), dilute magnetic semiconductors (DMS), Multiferroics, high T_c superconductors, Smart materials, materials for high temperature applications, ferroelectric, piezoelectric, multiferroic and magnetoelectric materials. Topological insulators, Shape memory alloys: NiTi, Heusler alloys, super-alloys. Nanomaterials. Synthesis and applications of carbon nanotubes, graphene and MoS_2. Recent discoveries and applications of materials.
Text Books:
1. Cullity B. D. and Graham C. D., Introduction to magnetic materials, IEEE press and Wiley publications, 2010.
2. Maekawa S., Concepts in Spin Electronics, Oxford University Press, 2006
3. Pillai S.O., Solid State Physics, New Age International, 8th edition, 2018.
4. Lagoudas D. C., Shape Memory Alloys: Modeling and Engineering Applications, Springer, 2008.

Reference books:
1. Rao MSR and Singh S, Nanoscience and nanotechnology: Fundamentals to frontiers, 1st edition, Wiley, 2017.
2. Callister W. D., Materials Science and Engineering: An Introduction, John Wiley & Sons, 2007
3. Wang Z. L. and Kang Z. C., Functional and Smart Materials Structural Evolution and Structure Analysis, 1st edition, Plenum Press, 1998

Course Code: SCL354
Course Title: NANOSCIENCE AND NANOTECHNOLOGY
Structure (L-T-P): 3-0-0
Pre-requisite: NIL
Course Objectives:
(i) To understand the fundamentals of nanoscience
(ii) Introduce about different classes of nanomaterials
(iii) To instruct basic knowledge on various synthesis and characterization techniques involved in nanotechnology (iv) To make the learner familiarize with applications of nanotechnology
Contents:
Introduction and basics: Scientific revolutions, Time and length scale in structures, definition of a nanosystem, Dimensionality and size dependent phenomena, Surface to volume ratio, Properties at nanoscale: optical, electronic and magnetic. Quantum Dots, Quantum Wells and Quantum Wires, Carbon based nanomaterials: buckyballs, nanotubes, graphene. Synthesis of nanomaterials: Chemical and Physical methods. Nanofabrication: Photolithography and its limitation-electron-beam lithography (EBL), Nano imprint, Soft lithography patterning. Characterization: Scanning Electron Microscopy (SEM), Transmission Electron Microscope (TEM), Atomic force microscopy (AFM). Applications: Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Coulomb blockade, Single electron transistor, Linear and nonlinear optical and electro-optical properties, Applications in displays and other devices, Nanomaterials for data storage, Sensors.
Text Books:
1. Rao MSR and Singh S, Nanoscience and nanotechnology: Fundamentals to frontiers, 1st edition, Wiley, 2017.
2. Pradeep T., NANO: The Essentials, Tata McGraw Hill India, 2007.
3. Poole C.P. and Owens F.J., Introduction to Nanotechnology, 1st edition, Wiley-Interscience, 2003.

Reference Books:
1. Nalwa H.S., Nanostructured Materials and Nanotechnology, 1st edition, Academic Press, 2002.
2. Hornyak G. L., Moore J.J., Tibbals H.F. and Dutta J., Fundamentals of Nanotechnology, 1st Edition, 2008.
3. Pradeep T., A textbook of nanoscience and nanotechnology, 1st edition, Tata McGraw Hill India, 2012.

Course Code: SCL457
Course Title: SEMICONDUCTOR MATERIALS AND OPTOELECTRONICS
Structure (L-T-P): 3-0-0
Pre-requisite: SCL154
Contents:
Semiconductor: Energy bands & charge carrier, E-k diagram, Semiconducting materials, Radiative and Non-radiative (Direct and Indirect) electron-hole recombination, Electron and hole concentrations, Fermi level, Genaration, recombination & injection, Junction, Heterojunction, Quantum wells & Superlattices, The Probabilities of (Band-to-Band) absorption and emission, Rate of absorption and emission, Electronic processes leading to luminescence, CIE Chromaticity diagram, Colour temperature, Colour Rendering Index, Lighting efficiency and efficacy, Colour Mixing, Thin films & its techniques of preparation, HT–ET layers.

Optoelectronics: LED, Phosphor Converted WLEDs, OLED, LCD & LED display, CFL. Photo-detector/Photo-conductor, Photodiodes, Solar cell, CCDs, Semiconducting laser,

Text Books:

1. Saleh, B. E. A. and Teich M. C., Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007), Ch.15, 16 and 17.
2. Ghione, G., Semiconductor Devices for High-Speed Optoelectronics, Cambridge University Press (2009).

Reference Books:

1. Yariv and Yeh P., Photonics: Optical Electronics in Modern Communication, Oxford University Press (2007), 6th Ed., Ch.15-17.
2. Bhattacharya, A. P., Semiconductor Optoelectronic Devices, Prentice Hall of India (1995). J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
3. Sze S.M. and Kwok K. Ng, Physics of Semiconductor Devices, 3ed Ed., Wiely, 2008.
4. Ben Streetman and Sanjay Banerjee, Solid State Electronic Devices, 7th Ed., Pearson 2016,
5. Callister, W. D., Materials Science and Engineering: An Introduction, 6th Ed., Wiley, 2003.

Course Code: SCL458
Course Title: MAGNETIC MATERIALS AND DEVICES
Structure (L-T-P): 3-0-0
Pre-requisite: SCL154
Contents:

Magnetic permeability, Magnetisation, origin of magnetic moment, Classification of magnetic materials, Domains and Hysteresis, Magnetis anisotropy, soft and hard magnetic materials, Superparamagnetism, Spintronics, Superconductivity: general features of superconductors, Type-I and Type-II Superconductors, Flux quantization, Quantum tunnelling, Applications of superconductivity, Production of low magnetic field using Helmholtz coils, solenoid, electromagnets and high magnetic field using superconducting magnets, Hall probe, search coils, flux meters and GMR devices, Magnetic storage, Faraday and Kerr effects, Vibrating sample magnetometer, SQUID, MRI, NMR and MFM.

Text Books:

1. Pillai, S. O., Solid State Physics, 6th Ed., New Age International, New Delhi, 2010.
2. Cullity, B. D., Introduction to Magnetic Materials. 2nd-Edition. California, London: Addison- Wesley Publications, 2008.

Reference Books:

1. Rose-Innes, A. C. and Rhoderick E. H., Introduction to Superconductivity. 2nd-Ed., Oxford: Pergamon Press, 1978.
2. Spaldin, N. A., Magnetic Materials Fundamentals Applications. 2nd-Ed., Cambridge university press, 2003.