

B TECH in CIVIL ENGINEERING

Year	THIRD SEMESTER										FOURTH SEMESTER											
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C				
II	MAT 2154	Engineering Mathematics – III	2	1	0	3	MAT 2255	Engineering Mathematics – IV	2	1	0	3										
	CIE 2151	Fluid Mechanics	3	1	0	4	CIE 2251	Basic Reinforced Concrete Design	3	1	0	4										
	CIE 2152	Highway Engineering	3	1	0	4	CIE 2252	Building Material Technology	2	0	3	3										
	CIE 2153	Mechanics of Structures	3	1	0	4	CIE 2253	Engineering Geology	2	1	0	3										
	CIE 2154	Surveying	3	1	0	4	CIE 2254	Waste water Management	2	1	0	3										
	CIE 2155	Water Supply Engineering	3	0	0	3	CIE 2255	Water Resource Engineering	2	1	0	3										
	CIE 2161	Material Testing Lab	0	0	3	1	****	Open Elective – I	3	0	0	3										
	CIE 2162	Surveying Practice – I	0	0	3	1	CIE 2261	Building Design and Drawing	0	0	3	1										
						CIE 2262	Fluid Mechanics Lab	0	0	3	1											
			17	5	6	24			16	5	9	24										
			FIFTH SEMESTER										SIXTH SEMESTER									
III	HUM 3152	Essentials of Management	2	1	0	3	HUM 3151	Engineering Economics and Financial Management	2	1	0	3										
	CIE 3151	Analysis of Indeterminate Structures	3	1	0	4	CIE 3251	Applied Soil Engineering	2	1	0	3										
	CIE 3152	Basic Structural Steel Design	3	1	0	4	CIE 3252	Estimation, Costing and Valuation Practice	2	0	3	3										
	CIE 3153	Construction Management	3	0	0	3	CIE 3253	Railway and Airport Engineering	2	1	0	3										
	CIE 3154	Geotechnical Engineering	3	1	0	4	CIE ****	Program Elective – I	3	0	0	3										
	****	Open Elective - II	3	0	0	3	CIE ****	Program Elective –II	3	0	0	3										
	CIE 3161	Computer Applications Lab	0	0	3	1	****	Open Elective – III	3	0	0	3										
	CIE 3162	Environmental Engineering Lab	0	0	3	1	CIE 3261	Structural Design and Drawing	0	0	3	1										
CIE 3163	Soil Mechanics Lab	0	0	3	1	CIE 3262	Surveying Practice – II	0	0	3	1											
			17	4	9	24			17	3	9	23										
			SEVENTH SEMESTER										EIGHTH SEMESTER									
IV	CIE****	Program Elective – III	3	0	0	3	CIE 4298	Industrial Training	0	0	0	1										
	CIE****	Program Elective –IV	3	0	0	3	CIE 4299	Project Work/Practice School	0	0	0	12										
	CIE****	Program Elective –V	3	0	0	3	CIE 4296	Project Work (Only for B.Tech honour Students)				20										
	CIE****	Program Elective – VI	3	0	0	3																
	CIE****	Program Elective – VII	3	0	0	3																
	****	Open Elective - IV	3	0	0	3																
			18	0	0	18																

Minor Specialization

I. Building Construction and Management

CIE 4051: Advances in Concrete Technology
CIE 4052: Building Code and Requirements
CIE 4053: Construction Materials and Quality Management
CIE 4054: Precast Technology

II. Environmental Engineering

CIE 4055: Air Pollution and Control
CIE 4056: Environmental Impact Assessment and Auditing
CIE 4057: Industrial Waste water Treatment
CIE 4058: Solid Waste Management

III. Geotechnical Engineering

CIE 4059: Design of Foundations and Earth Retaining Structures
CIE 4060: Geo-Environmental Engineering
CIE 4061: Ground Improvement Techniques
CIE 4062: Soil Reinforcement and Geosynthetics

IV. Structural Engineering

CIE 4063: Design of Reinforced Concrete Structures
CIE 4064: Design of Steel Structures
CIE 4065: Finite Element Method of Analysis
CIE 4066: Pre-stressed Concrete Design

V. Transportation Engineering

CIE 4067: Urban Mass Transport System
CIE 4068: Urban Transport Planning
CIE 4069: Pavement Materials and Design
CIE 4070: Traffic Systems and Engineering

VI. Water Resources Engineering

CIE 4071: Integrated Watershed Management
CIE 4072: Hydraulics and Hydraulic Machines
CIE 4073: Hydrological Analysis
CIE 4074: Water Resources Planning and Management

VII. Material Science

PHY 4051: Physics of Low Dimensional Materials
PHY 4052: Physics of Photonic & Energy Storage Devices
CHM 4051: Chemical Bonding
CHM 4052: Chemistry of Carbon Compound

VIII. Business Management

HUM 4051: Financial Management
HUM 4052: Human Resource Management
HUM 4053: Marketing Management
HUM 4054: Operation Management

IX. Computational Mathematics

MAT 4051: Applied Statistics and Time Series Analysis
MAT 4052: Computational Linear Algebra
MAT 4053: Computational Probability and Design of Experiments
MAT 4054: Graphs and Matrices

Program Electives

CIE 4075: Bridge Engineering
CIE 4076: Coastal Engineering
CIE 4077: Contract Management
CIE 4078: Elements of Earthquake Engineering
CIE 4079: Fecal Sludge and Septage Management
CIE 4080: Non-Destructive Testing of Concrete structures
CIE 4081: Remote Sensing and GIS

Open Electives

CIE 4301: Air and Noise Pollution
CIE 4302: Contract Management for Engineers
CIE 4303: Environmental Management
CIE 4304: Geology for Engineers
CIE 4305: Introduction to Remote Sensing and GIS
CIE 4306: Strength of Materials

THIRD SEMESTER

MAT 2154: ENGINEERING MATHEMATICS III [2 1 0 3]

Gradient, divergence and curl. Line, surface and volume integrals. Green's, Gauss divergence and Stokes' theorems. Fourier series of periodic functions. Half range expansions. Harmonic analysis. Fourier integrals. Sine and cosine integrals, Fourier transform, sine and cosine transforms. Partial differential equation- Basic concepts, solutions of equations involving derivatives with respect to one variable only. Solutions by indicated transformations and separation of variables. One dimensional wave equation, one dimensional heat equation and their solutions. Introduction to probability: finite sample space, conditional probability and independence. Bayes' theorem, One dimensional random variables: Mean and variance. Two and higher dimensional random variables: mean, variance, correlation coefficient and regression

References:

1. Murray R. Spiegel, Vector Analysis, Schaum Publishing Co., 1959.
2. Erwin Kreyszig, Advanced Engineering Mathematics, (9e), Wiley Eastern, 2006.
3. P. L. Meyer, Introduction to Probability and Statistical Applications, (2e), Oxford and IBH Publishing, Delhi, 1980.
4. B. S. Grewal, Higher Engineering Mathematics, (43e), Khanna Publishers, 2014.

CIE 2151: FLUID MECHANICS [3 1 0 4]

Introduction, Fluid Properties and Classification of Fluid, Pressure and its Measurement, Hydrostatics, Kinematics of Fluid Motion, Dynamics of Fluid Motion, Ideal Fluid Flow, Laminar Flow Through Pipes, Turbulent Flow Through Pipes, Flow Measurement, Flow in open Channels

References:

1. Streeter V.L. and Wiley E.B, Fluid Mechanics, McGraw Hill book Co., New York. 1998
2. Modi P.N. and Seth S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi. 2005
3. Bansal R. K, Fluid Mechanics and Hydraulic Machines, Laxmi Publishers, New Delhi. 2010
4. Jain A.K., Fluid Mechanics, Khanna Publishers, New Delhi. 2002
5. Garde R.J., Fluid Mechanics through problems, New age international Pvt. Ltd., Publishing, New Delhi. 2003

CIE 2152: HIGHWAY ENGINEERING [3 1 0 4]

Introduction, Design of Geometry of Highway on various terrains, Design of Horizontal Alignments and setting out of Horizontal Alignments, Design of Vertical Alignments and setting out Vertical Alignments, Study of Traffic flow and design of traffic flow control system, Design of Flexible and Rigid Pavements as per IRC method, Design of Highway drainage, Highway Economics, Highway maintenance and Evaluation.

References:

1. Khanna S.K and Justo C.E.G., Highway Engineering, (10e), Nemchand and Bros., Roorkee 2015.
2. Kadiyali L.R., Traffic Engineering and Transportation Planning (5e), Khanna Publisher, New Delhi 2000.
3. E.J. Yoder, Principles of Pavement Design, John Wiley & Sons, Inc. New York, 1975.
4. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003.

CIE 2153: MECHANICS OF STRUCTURES [3 1 0 4]

Analysis of determinate trusses, bending moment and shear force diagrams, bending and shear stresses, Torsion of circular shaft, Stability of columns, Stress on inclined planes, Analysis of three hinged parabolic Arches. Determination of deflection in beams, simple frames and trusses by strain energy methods-Unit load method, Castiglano's method, Mecaulay's method, Moment -area method and Conjugate beam method.

References:

1. Timoshenko, Strength of Materials Vol. I & Vol. II, CBS Publishers & Distributers, New Delhi, 2002.
2. James M Gere & Stephen P Timoshenko, Mechanics of Materials, CBS Publishers & Distributers, New Delhi, 2004.
3. Basavarajaiah & Mahadevappa, Strength of Materials, CBS Publishers, 2001.
4. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill, New Delhi, 2004.
5. Ramamrutham & Narayanan, Strength of Materials, Dhanpat Rai Publishers, 1989.

CIE 2154: SURVEYING (3 1 0 4)

Introduction, Compass Survey, Plane Table survey, Levelling, Simple leveling, Differential leveling, Errors in Levelling, Reciprocal Levelling, Contours, Application and uses, Methods in Contouring, Characteristics of contours, Theodolite Survey, Repetition and Reiteration methods Temporary adjustments of theodolite, Trigonometric levelling using height and distance formulae, Tacheometry, Photogrammetric Surveying, Aerial Photogrammetry, Under Ground Surveys, Hydrographic Survey.

References:

1. Punmia B.C., Surveying, Vol. I and II, Lakshmi Publishers, New Delhi, 2015
2. Duggal S.K., Surveying, Vol. I and II, Tata McGraw Hill – Publishing Co.Ltd, New Delhi, 2017
3. Arora K.R., Surveying, Vol. (I, II, III), Standard Book house, New Delhi, 2015
4. Kanetkar T.P and Kulkarni S.V, Surveying and levelling parts 1 and 2, Pune Vidyarthi Griha Prakashan, 2008
5. Thomas Norman, Surveying, Edward Arnold Publishers (ELBS), Budapest.

CIE 2155: WATER SUPPLY ENGINEERING [3 0 0 3]

Introduction, Quantity of water, Population forecasting, Sources of water, characteristics of water and water quality analysis, drinking water standards, treatment of water:- aeration, sedimentation, coagulation, filtration, disinfection, water softening and other treatments, distribution of water, layout of distribution, pipe appurtenances, leakage detection, corrosion and control.

References:

1. Manual on water supply and treatment CPHEEO, Ministry of Urban development, New Delhi 1991.
2. Garg S.K., Environmental Engg.-I, Khanna Publishers, New Delhi 1999.
3. Birdie G.S., Water Supply and Sanitary Engg., Dhanpath Rai and Sons, New Delhi 1987.
4. B.C. Punmia, Water Supply and Sanitary Engg., Dhanpath Rai and Sons, New Delhi.
5. Modi and Sethi, Water Supply and Sanitary Engg., Dhanpath Rai and Sons, New Delhi.

CIE 2161: MATERIAL TESTING LAB [0 0 3 1]

Tension test on mild steel, Compression test on cast iron and timber, Shear test on mild steel specimen, Torsion test on mild steel specimen, Rockwell hardness test, Brinell's Hardness test, Bending test on wood, Impact tests (Izod and Charpy), Fatigue test on mild steel, Tension test and Compression test on Aluminium, Tests on Bitumen.

References:

1. Suryanarayana A.V.K., Testing of Metallic Materials, Prentice Hall of India, New Delhi. (1990)
2. Khanna & Justo, Highway Materials Testing, Nemchand and brothers. (1989)
3. Technical Teachers' Training Institute, Laboratory Manual of Strength of Materials, Oxford University Press. (1983)
4. Relevant IS Codes.

CIE 2162: SURVEYING PRACTICE – I [0 0 3 1]

Traversing using Chain and Compass, Plane table surveying- Radiation and intersection methods, Solving three point problem by Bessel's solution, Levelling- Differential Levelling, Reciprocal and Block levelling, Tacheometric surveying- Determination of constant, Gradient of a line, Theodolite – Repetition and Reiteration, Single plane and Double plane method, Successive Bisection, Offset from chord produced, Setting out- Building, Pipeline, bridge.

References:

1. Kanetkar T.P. and Kulkarni S.V, Surveying and leveling-Part I and II, Vidyarthi Griha Prakashana - Pune. 1996
2. Punmia B.C., Surveying - Vol. I, Lakshmi Publications, New Delhi, 2005
3. Arora K.R., Surveying, Vol. I and II, Standard Book House, New Delhi, 1993
4. David Clark Plane and Geodetic Surveying for Engineers, Vol I and II – CBS publication and Distributers, New Delhi, 1983
5. Thomas Norman, Surveying, Edward Arnold Publishers (ELBS), Budapest.

FOURTH SEMESTER**MAT 2255: ENGINEERING MATHEMATICS IV [2 1 0 3]**

Numerical solutions of partial differential equations by finite difference methods, five-point formula, Laplace Poisson Equations, Heat equation, Crank Nicolson's method, Wave equation., Introduction to calculus of variations, geodesics, isoperimetric problems, approximate methods, Weighted Residual Approach, Least square method. Application of Finite Difference technique: Statically determinate and indeterminate beams, Buckling of columns. Introduction to Tensor Analysis, Distributions: binomial, Poisson, uniform, normal, gamma, chi-square and exponential. Moment generating function, Functions of one dimensional and two dimensional random variables, Sampling theory, Central limit theorem and applications. Optimization Techniques: Introduction to Linear programming, Formation of Linear Programming problem, solution by graphical method, Simplex method. Two phase simplex method, Transportation problems..

References:

1. M Rajasekaran S, Numerical methods for Science and Engineering, Wheeler and Co. Pvt. Ltd., Allahabad, 1992.
2. Sastry S.S., Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1995.
3. A. R. Mitchel and R. Wait, Finite Element Methods in Partial Differential Equations, John Wiley, 1997.
4. P. L. Meyer, Introduction to Probability and Statistical Applications, (2e), Oxford and IBH Publishing, Delhi, 1980.

- Hamdy A. Taha, Operation research, (8e), PHI, 2007.
- S. Narayanan, T. K. Manicavachagom Pillay, G. Ramanaiah, Advanced mathematics for engineering students, S. Viswanathan Pvt. Ltd., 1985.

CIE 2251: BASIC REINFORCED CONCRETE DESIGN [3 1 0 4]

Role of reinforcement, behavior of RCC section. Straight line Theory– Moment of Resistance of singly reinforced and doubly reinforced beam sections. Limit state method: Design of rectangular beams (singly and doubly reinforced), flanged beams, Design for Shear and Torsion. Design of one way and two-way slabs for various boundary conditions Limit state of collapse in compression, Design of axially loaded short and slender R.C. Columns, uniaxial and bi-axial bending using SP16 hand book. Determination of short term and long-term deflections of R.C. beams, Determination of Crack width. Design of column footings.

References:

- Karve S.R, and Shah V.L., Limit State Theory and Design of Reinforced Concrete, Structures Publishers, Pune, 1996.
- Varghese P.C., Limit State Design of Reinforced Concrete, Prentice Hall of India, New Delhi, 1999.
- Shah H.J., Reinforced concrete, Vol. I, Charotar Publishing house, Anand, 2005.
- CODE BOOKS: IS: 456 – 2000, Code of practice for plain and Reinforced concrete, Bureau of Indian Standards, New Delhi.
- SP-16 – 1984, Design Aids for Reinforced concrete IS 456. Bureau of Indian Standards, New Delhi

CIE 2252: BUILDING MATERIAL TECHNOLOGY [2 0 3 3]

Theory-Masonry Blocks, Types of bonding, Flooring Tiles and Pavement Blocks, Standard specification and Quality Control, Aggregates: Types, Functional requirements, Standard specifications, Quality Control, Cement: Types, Functional requirements, Chemical Composition, Hydration, Standard specifications, Quality Control Tests, Concrete : Types, Grades, Functional requirements, Environmental Conditions, Standard Specifications, Quality Control tests on Fresh and Hardened Concrete. Concrete Mix Design: Mix Design procedure as per IS 10262: 2009

Laboratory- Tests on Aggregates, Cement, Fresh and Hardened Concrete

References:

- Sushil Kumar, Building Construction, Standard Publication 1976
- Shetty M.S., Concrete Technology, S. Chand and Co. 2006
- Neville and Brooks, Concrete Technology, Pearson Education, 2003
- Singh Gurucharan, Materials of Construction, Standard Publishers. 1988)
- Relevant Handbooks : SP 20-1991, SP10-1975, SP:62 (S&T) :1997, National Building Code, BIS, New Delhi 1988

CIE 2253: ENGINEERING GEOLOGY [2 1 0 3]

Introduction, Physical Geology: Origin of Earth, Interior structure of Earth. Seismology, Plate Tectonics, Earthquakes. Tsunamis. Introduction to minerals and rocks. Engineering properties of important rocks used as building materials. Weathering of rocks, Soil forming processes. Landforms and processes associated with river, wind, and groundwater. Structural Geology, Groundwater, .Engineering Geology., Landslides. Remote sensing & GIS and their applications in Civil Engineering, Geophysical methods –Seismic and electrical methods for subsurface investigations, engineering solutions to control climate change.

References:

- Parbin Singh, Engineering Geology, S.K. Kataria and Sons, New Delhi. 2002

- Mukherjee P.K., A text book of Geology, World Press, Kolkata 2003
- Venkata Reddy D., Engineering Geology for Civil Engineering, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 1995

CIE 2254: WASTE WATER MANAGEMENT [2 1 0 3]

Introduction, system of sewage disposal, quantity of sanitary sewage, construction and laying of sewerage system, sewer appurtenances, characteristics of sewage, treatment of sewage, unit operations, unit process, disposal of sewage, IS standards, self purification of streams, industrial effluent treatment, common effluent treatment plant.

References:

- Garg S. K., Environmental Engg.- II, Volume – II, Khanna Publishers, New Delhi 2014.
- Birdie G.S., Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi 1987.
- IS Standards 2490 - 1974 ,3360 – 1974, 3307 – 1974, Indian Standard Institution, ManakBhavan, New Delhi.
- Manual on sewage and sewage treatment CPHEO, Ministry of Urban development, New Delhi.
- Standard Methods – APHEA, American Public Health Association, 1015 Fifteenth Street, NW Washington DC.

CIE 2255: WATER RESOURCES ENGINEERING [2 1 0 3]

Introduction, Hydrology – precipitation, evapotranspiration, infiltration & runoff, flood studies and hydrographs, Estimation of reservoir capacity and planning, Hydraulic structures- dams- classification & design of gravity dam, Diversion head works-components; Bligh's Creep Theory

References:

- Viessman and Knapp, Introduction to Hydrology, Harper and Row Publishers, Singapore. 1989
- H.M.Raghunath, Hydrology, Wiley Eastern publications, Delhi. 1985
- Modi.P.N, Irrigation, water resource and water power, Standard book house publications, Delhi. 1988
- R. K. Sharma, T. K. Sharma, Irrigation Engineering, S.Chand and Co., New Delhi. 2002
- Santhosh Kumar Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, Delhi. 1998

CIE 2261: BUILDING DESIGN AND DRAWING [0 0 3 1]

Foundations: Details drawing for different types of foundations - stepped wall foundations, RCC Isolated Footings. Doors and Windows: Detailed drawing for Wooden doors with Fully panelled, Partial panelled and partial glazed, Wooden windows with Fully panelled, Partial panelled and partial glazed. Design and Drawing of Residential Buildings: Functional design of building (Residential, Public and Industrial), positioning of various components of buildings, orientation of buildings, building standards, bye laws, set back distances and calculation of carpet area, plinth area and floor area ratio. Plan, Elevation and Sectional views of Single bedroom house with RCC roof. Introduction to Auto cad: Functional design of building using inter connectivity diagrams (bubble diagram), development of line diagram for health centre, Primary school building, Bank etc. For a given single line diagram, preparation of water supply, sanitary and electrical layouts

References:

- Balagopal Pabhu T.S., Vincent Paul K. and Vijayan C., Building Design of Civil Engg. Drawing, Spades Publishers, Calicut. 1999
- Shah and Kale, Principle of Building Drawing, Tata McGraw Hill

- Publishing Co., New Delhi. 1985
- Sharma and Kaul, Text book of Building Construction, S. Chand, New Delhi. 1976
 - Gurucharan Singh, Building Construction, Standard Publishers & distributors New Delhi.
 - IS National Building Code – 1970.

CIE 2262: FLUID MECHANICS LAB [0 0 3 1]

Calibration of Triangular Notch, Rectangular Notch, Cippoletti Notch, Venturimeter, Orifices, Mouth pieces, Orifice meter, Broad crested weir, Curved weir, Ogee weir, Plug Sluice, Determination of Friction factor of pipes, Experiment on Venturi flume, Standing wave flume, Demonstration of Parshall Flume.

References:

- Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics Standard Book House, New Delhi. 2005
- Jain A.K., Fluid Mechanics, Khanna Publishers, New Delhi 2002
- Streeter V.L and Wiley E.B., Fluid Mechanics, McGraw Hill Co. New York 1998
- Bansal R. K. Fluid Mechanics and Hydraulic Machines, Laxmi Publishers, New Delhi 2010

FIFTH SEMESTER

HUM 3152: ESSENTIALS OF MANAGEMENT [2 1 0 3]

Definition of management and systems approach, Nature & scope. The functions of managers. Corporate social responsibility. Planning: Types of plans, Steps in planning, Process of MBO, How to set objectives, Strategies, policies & planning premises. Strategic planning process and tools. Nature & purpose of organising, Span of management, Factors determining the span, Basic departmentation, Line & Staff concepts, Functional authority, Art of delegation, Decentralisation of authority. HR planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership- leadership behaviour & styles, Managerial grid. Basic control process, Critical control points & standards, Budgets, Non-budgetary control devices. Profit & loss control, Control through ROI, Direct, Preventive control. Managerial practices in Japan & USA, Application of Theory Z. The nature & purpose of international business & multinational corporations, Unified global theory of management. Entrepreneurial traits, Creativity, Innovation management, Market analysis, Business plan concepts, Development of financial projections

References:

- Harold Koontz & Heinz Weihrich., Essentials of Management, McGraw Hill, New Delhi, 2012.
- Peter Drucker., Management: Tasks, Responsibilities and Practices, Harper and Row, New York, 1993.
- Peter Drucker., The Practice of Management, Harper and Row, New York 2004.

CIE 3151: ANALYSIS OF INDETERMINATE STRUCTURES [3 1 0 4]

Analysis of two hinged parabolic arches, Analysis of statically indeterminate beams by strain energy method, consistent deformation method and three moment theorem. Analysis of statically indeterminate beams and frames by slope deflection and moment distribution methods. Plastic Analysis of beams and frames to identify collapse mechanisms and determine the collapse loads. Analysis of beams and frames by stiffness matrix method. Influence line diagrams and Muller Breslau principle.

References:

- Reddy C.S., Basic structural Analysis, Tata McGraw Hill, New Delhi, 2010.
- Ramamrutham S., Theory of Structures, Dhanpat Rai Publishing Company, New Delhi 2014.
- Rao Prakash D.S., Structural Analysis, Universities Press, India 1997.
- Hibbeler RC., Structural analysis, Pearson Education, United States 2015.
- Daniel L Schodak., Structures, Pearson Education, United States 2015.

CIE 3152: BASIC STRUCTURAL STEEL DESIGN [3 1 0 4]

Introduction to steel structure, bolted connections, and welded connections. Design of Tension members, compression members, column splices, column base, and gusseted base. Design of Flexural member, built up sections. Design of Plate girders.

References:

- Duggal S.K., Limit State Design of Steel Structures, Tata McGraw Hill education private Limited – New Delhi 2008.
- Subramanian N., Design of Steel Structures, oxford university New Delhi 2008.
- IS 800-2007, General construction of steel in code of practice, Bureau of Indian Standards, New Delhi.
- SP-6 (Part I) 1964, Structural Steel Sections. Bureau of Indian Standards, New Delhi

CIE 3153: CONSTRUCTION MANAGEMENT [3 0 0 3]

Introduction to Construction Management- Classification of construction works, various stages in the Construction of a Project, construction team, Work Breakdown Structure. Planning for Construction Projects- Steps involved in planning, Objectives of planning, Stages of planning, Stages of planning by different agencies. Scheduling– Definition, Preparation of construction schedules, Advantages, Bar charts and Milestone charts – Preparation, Merits, Demerits. Network Analysis-Introduction, Terms and definition, Network representation, Rules for drawing a network diagram, Fulkerson's rule for numbering the events.

Pert Analysis– Time estimates, Calculation of slack, critical path, probability of completion time of project. CPM analysis- Differences between CPM and PERT, Calculation of float, critical path. Cost Analysis, Project updating. Management of Construction equipment- Classification of construction equipment, factor affecting selection of construction equipment, Planning of construction equipment, Economic life of equipment, preventive maintenance and repairs, cost of owning and operation of construction equipment and related problems, Introduction to earthmoving, hoisting, hauling equipment, aggregate crushers, tunneling, and paving equipment.

References:

- Dr. Seetharaman. S., Construction Engg. and Management, Umesh Publication. 1997
- Sengupta B., Guha M, Construction Management and Planning McGraw Hill Companies. 1998
- Dr. Punmia B.C. and Khandelwal K.K., Project Planning and Control with PERT and CPM Laxmi Publication 2002
- Varma Mahesh, Construction equipment and its planning and application, Metropolitan Publication. 1987

CIE 3154: GEOTECHNICAL ENGINEERING [3 1 0 4]

Introduction, Soil structure, Clay minerals, Index properties of soil, Total, effective and neutral stresses, Flow through soil, Seepage through soils, Compaction of soil, Stress distribution in soil, consolidation of soil,

Shear strength of soil –Direct shear, Triaxial, Unconfined compression and vane shear tests, Drained, undrained and consolidated undrained tests and their applications.

References:

1. Bowles J.E., Foundation Analysis and Design, (4e), McGraw-Hills Book Company, 1998.
2. Punmia B.C., Jain AK and Jain AK ., Soil Mechanics and Foundations, (17e), Laxmi Publications Pvt. Ltd., 2017
3. Arora K.R., Soil Mechanics and Foundation Engineering, (7e), Standard, Publishers and Distributors, 2011.
4. Murthy V.N.S., A Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers & Distributors-New Delhi, 2008.
5. Gopal Ranjan and. Rao A.S.R., Basic and Applied Soil Mechanics, New Age International Pvt. Limited, Publishers, 2016.

CIE 3161: COMPUTER APPLICATION LAB [0 0 3 1]

Introduction to STAAD Pro. software package- modeling and analysis of continuous beams, plane trusses, plane frames, and space frames using STAAD Pro. Design of frames using STAAD Pro. Introduction to ETABS – modeling and analysis of 3D space frames.

References:

1. Sharma T.S., STAAD Pro. V8i for beginners – with Indian examples (1e), Notion Press 2014
2. Rajendran D., Analysis & Design of a Multistorey Building using STAAD.Pro & E-TABS (with Manual Calculation) (1e), Designtech Publishers 2016
3. Bentley, STAAD Pro. – Technical Reference Manual, Retrieved from https://communities.bentley.com/cfs-file/_key/telligent-evolution-components-attachments/13-275895-00-00-00-24-18-Technical_5F00_Reference_5F00_V8i.pdf 2012
4. Computers and Structures, Inc., CSI Analysis Reference Manual, Retrieved from <http://docs.csiamerica.com/manuals/etabs/Analysis>

CIE 3162: ENVIRONMENTAL ENGINEERING. LAB [0 0 3 1]

Determination of solids - total solids, suspended solids, dissolved solids, volatile solids, fixed solids, settleable solids. Turbidity determination and Jar test. Determination of Alkalinity, Acidity and pH. Determination of Calcium, Magnesium and total Hardness. Determination of Chlorides Determination of dissolved oxygen. Residual chlorine and chlorine demand. Determination of percentage available chlorine in Bleaching powder. Determination of Iron and Fluorides. Determination of B.O.D. Determination of C.O.D., Total count test and MPN, Determination of Ammonical Nitrogen and Nitrates. Demonstration of High volume sample and sound lever meter. Demonstration of determination of oil, grease and Sulphates.

References:

1. Standard Methods for the Examination of Water and Waste Water – ALPHA – AWWA – WPCF
2. Sawyer and Mc Carty, Chemistry for Environmental Engineering, McGraw Hill, New York 1994.,
3. IS – 3025 – 1964 – Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry, IIT New Delhi.
4. Drinking water Standards IS – 10500-2012.

CIE 3163: SOIL MECHANICS LAB [0 0 3 1]

Determination of moisture content, specific gravity, Atterberg limits, In-situ unit weight, Sieve analysis, Coefficient of permeability by constant head and variable head permeameter, Standard compaction test, Use of proctor needle, Triaxial shear test, Unconfined compression test, Direct

shear test, Vane shear test, Determination of CBR, Demonstration of Plate load test, Cone penetration test and hydrometer analysis.

References:

1. Relevant IS codes
2. Bowles J.E., Engineering properties of soil and their measurement, (2e), McGraw – Hill Book Company, New York, 1986.
3. Lambe T.W, Soil testing for Engineers, John Wiley and Sons, INC.
4. Cheng Liu and Jack B. Evett, Soil properties, Testing, Measurement and Evaluation, Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 1987.

SIXTH SEMESTER

HUM 3151: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

Nature and significance, Micro & macro differences, Law of demand and supply, Elasticity & equilibrium of demand & supply. Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of single, Uniform gradient cash flow. Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, Declining balance method of depreciation, Sum-of-the-years digits method of depreciation, Sinking fund and service output methods, Introduction to balance sheet and profit & loss statement. Ratio analysis - Financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios.

References:

1. Prasanna Chandra., Fundamentals of Financial Management, Tata Mc-Graw Hill Companies, New Delhi, 2005.
2. James L Riggs, David D Bedworth and Sabah U Randhawa., Engineering Economics, Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2004.
3. T. Ramachandran., Accounting and Financial Management, Scitech Publications Pvt. Ltd. India, 2001.
4. Eugene F. B. & Joel F. H., Fundamentals of Financial Management, (12e), Cengage Learning Publisher, 2009.
5. M. Y. Khan & P.K. Jain., Financial Management, (5e), Tata McGraw Hill Publication, New Delhi, 2008.
6. Thuesen G.J., Engineering Economics, Prentice Hall of India, New Delhi, 2005.
7. Blank Leland T. Tarquin Anthony J. Engineering Economy, McGraw Hill, Delhi, 2002.
8. Chan S. Park, Fundamentals of Engineering Economics, (3e), Pearson Publication, 2013.

CIE 3251: APPLIED SOIL ENGINEERING [2 1 0 3]

Soil Exploration, Earth pressure at rest, active and passive conditions, Stability of slopes - Finite and infinite slopes, Bearing capacity of shallow footings, Pile foundations, Pile driving, Load carrying capacity of a single pile using static formula, Group action and negative skin friction, Settlement of pile foundations, Under-reamed piles and bored compaction piles.

References:

1. Bowles J.E., Foundation Analysis and Design, (4e), McGraw-Hills Book Company, 1998.
2. Punmia B.C., Jain AK and Jain AK ., Soil Mechanics and Foundations,

- (17e), Laxmi Publications Pvt. Ltd., 2017
- Arora K.R., Soil Mechanics and Foundation Engineering, (7e), Standard, Publishers and Distributors 2011.
 - Murthy V.N.S., A Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers & Distributors-New Delhi, 2008.
 - Gopal Ranjan and. Rao A.S.R., Basic and Applied Soil Mechanics, New Age International Pvt. Limited, Publishers, 2016.

CIE 3252: ESTIMATION, COSTING AND VALUATION PRACTICE [2 0 3 3]

Theory: Introduction to Estimation, Definition, Purpose, Types, work charged establishment. Approximate estimate, Method of measurement of work as per IS 1200, Introduction to methods of estimation of buildings, center line method, long and short wall method. Specification and analysis of rates of different items of building, Different types and methods of valuation, Tender Documents and types of contract, Methods of earthwork estimation in roads, spot leveling, mass diagram

Practice: Quantity estimation of residential building, preparation of bar bending schedule for the given component of RC structure, Rate analysis for different components of building, Quantity Estimation of earth work in road formation, Quantity estimation of roads and culverts.

References:

- M. Chakraborti., Estimating, Costing, Specification & Valuation in Civil Engineering, (16e) Published by the Author, 2003.
- B.N. Dutta., Estimating and Costing in Civil Engineering, (16e), UBS Publishers' Distributors Ltd. 2000.
- CPWD., Manual for Standard Specification and Rate Analysis
- IS 1200: Part 1 to 16: Method of measurement of building and civil engineering work

CIE 3253: RAILWAY AND AIRPORT ENGINEERING [2 1 0 3]

RAILWAY ENGINEERING: Introduction, Tractive resistance, Permanent way, Alignment Details, Points and crossing, Track Junctions, Railway Station and Yards, Signals, Interlocking.

AIRPORT ENGINEERING: Introduction, Geometric Design, Airport Capacity and Designing of Terminal Area, Visual aids and Air traffic control system.

References:

- Saxena S C and Arora S P, A Text Book of Railway Engineering, (8e), Dhanpat Rai Publications (p) Ltd.-New Delhi, 2017.
- Khanna S K, Arora M G and Jain S S., Airport Planning and Design, (6e), Nemchand and Brothers Publications, Roorkee, 1999.
- Horenjeff, R. and McKelvey, F., Planning and Design of Airports, (4e), Mc Graw Hill Company, New York, 1994.
- Ashford, N. and Wright, P.H., Airport Engineering, (3e), John Wiley and Sons, New York, 1992.

CIE 3261: STRUCTURAL DESIGN AND DRAWING [0 0 3 1]

Detailing of singly and doubly reinforced rectangular beams. Detailing of one-way slabs, Two-way slabs and continuous beams. Design and detailing of Dog legged staircase, circular tank and rectangular tank. Detailing of isolated footing and column reinforcement. Design and Detailing of Cantilever retaining wall. Beam to beam and beam to column connections in steel buildings. Built-up Columns with lacings and battens.

References:

- Subramanian N., Design of Reinforced Concrete Structures (1e), Oxford University Press, 2013.
- Shah H.J., Reinforced Concrete – vol. 1 (Elementary Reinforced Concrete) (11e), Charotar Publishing House Pvt. Ltd., 2016

- Chandra R., Gehlot V., Elements of Limit State Design Of Concrete Structures, Scientific Publishers, 2004
- Gambhir M. L., Fundamentals of Structural Steel Design (1e), Tata McGraw Hill Publishing Co. Ltd., 2013
- Relevant Code and Hand Books : IS 456 (2000), SP 34 (1987), IS 800 (2007), SP 6 – 1 1964

CIE 3262: SURVEYING PRACTICE – II [0 0 3 1]

Curve setting out using Electronic theodolite- Simple curve by Rankine's method, Compound Curve, Reverse Curve, Transition Curve (Bernoulli Lemniscate), Simple Curve using chain and tape-Radial and Perpendicular offset, Demonstration of minor instruments-: Hand level, Clinometers, Abney level, Use of Planimeter, Box sextants, Nautical sextants, Ceylonthat tracer, Application of any one Minor instrument, Total Station- Measurement of Vertical and Horizontal angles, Distance, Minor project using Total station.

References:

- Punmia B.C., Surveying and levelling, Vol. I and II, Lakshmi Publishers, New Delhi. 2005

SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

EIGHTH SEMESTER

CIE 4298: INDUSTRIAL TRAINING

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

CIE 4299: PROJECT WORK/PRACTICE SCHOOL

The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

PROGRAM ELECTIVES

CIE 4051: ADVANCES IN CONCRETE TECHNOLOGY [3 0 0 3]

Microstructure and Properties of Hardened Concrete, Introduction, Microstructure of Concrete, Strength, Dimensional Stability, Durability, Hydraulic Cements, Aggregates, Admixtures, Proportioning Concrete Mixtures, Concrete at Early Age, Nondestructive Methods, Concrete Materials, Mix Proportioning, and Early-Age Properties, Advances in Concrete Technology, Special Types of Concrete, Concrete Mechanics.

References:

- Monteiro and Mehta Concrete: Microstructure, Properties, and Materials, (4e), McGraw-Hill 2014.

CIE 4052: BUILDING CODE AND REQUIREMENTS [3 0 0 3]

Introduction to National Building Code:- Scope and Terminologies, Administration:- Building Permit and Inspection, General building requirements:- Land Use classification, Classification of Buildings, Area and Height Limitations, Requirements of various parts of Building. Fire and Safety: fire prevention, life safety, Design and Construction:- construction practices and safety, Earth quake resistant of masonry wall, Wind load design, Building Services:- Plumbing, Lighting and ventilation, Acoustics, Sound Insulation and Heat Insulation in buildings.

References:

1. National Building Code of India 2005
2. SP 64 (2001), SP 7 (2005), Bureau of Indian Standards

CIE 4053: CONSTRUCTION MATERIALS AND QUALITY MANAGEMENT [3 0 0 3]

Integrated material Management: Meaning, Functions, and Advantages. Selective Control, Codification and Standardization. Material planning budgeting and procuring. Price forecasting, Purchasing under uncertainties, Purchasing Capital equipment. Source selection. Foundations of Total Quality Management: Understanding quality, TQM philosophy: Concept of Ishikawa, Taguchi, Shingo philosophies. Models and frame works. TQM Tools: An overview of Flowcharts, Check sheets, Histogram, Cause and effect diagrams, Pareto diagram, Scatter diagram and Control charts. Introduction to ISO systems of quality assurance.

References:

1. Gopal Krishnanan P, Sundaresan M., Material Management Integrated Approach, Prentice Hall India, New Delhi. 1992
2. Datta A.K., Material Management and Inventory Control: Principles and Practice, Jaico Publishing House, Bombay. 1988
3. Woodside Gayle, Aurrichio Patrick ISO 14001, Auditing manual McGraw Hill, New Delhi. 2000
4. BhatSridhara K Total Quality Management, Himalaya Publication House, Mumbai. 2007
5. Oakland John S TQM, Text with cases, Butterworth- Heinemann, Oxford. 2006

CIE 4054: PRECAST TECHNOLOGY [3 0 0 3]

Introduction: Comparative advantages of precast constructions over in-situ constructions, Suitability of precast construction, Limitations of Precast construction. Types of Precast constructions- Structural Precast Systems, Precast Buildings, Housing, Apartment Buildings, Utility Buildings, Large Space buildings and Mixed Construction. Materials and Quality control-Production Process, Tolerance, Transportation and Erection.Modular Consideration and Standardization- General principles for Frame and skeletal structures, Bearing walls, Floors, Beams and Columns (types, modulations and connections).Design principles: Approaches to Design, Structural System and Overall Stability, Structural Integrity, Loads on Stability Elements, Connections-Basic Force Transfer Mechanism, Types of Connections, Earthquake Design

References:

1. Kim S. Elliott , Precast Concrete Structures, Butterworth- Heinemann, An imprint of Elsevier Science, 2002
2. FIP Planning and Design Handbook on Precast Building Structures, SETO Ltd., 1994
3. Hubert Bachmann, Alfred Steinle, Precast Concrete Structures, Ernst & Sohn GmbH & Co. KG, 2011
4. IS 10297-1982

CIE 4055: AIR POLLUTION AND CONTROL [3 0 0 3]

Definition, sources, classification, Behavior of air pollutants, Meteorological variables, stability conditions, plume rise and stack height, Effects of air pollution, Sampling, analysis and control, Global effects of air pollution, Air pollution act.

References:

1. Rao H.V.N. and Rao M.N. , Air pollution, Tata Mc Graw Hill, New Delhi 1989.
2. Rao C.S., Environmental Pollution control, Wiley Eastern Ltd. Delhi 1995.
3. Wark Kenneth and Wamer C.F, Air Pollution its Origin and Control. Harper and Row, Publ.
4. Sincero. A. Pand Sincero G.A. Environmental Engineering. Prentice Hall.
5. Air Pollution - Sampling and Analysis - APHA.

CIE 4056: ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING [3 0 0 3]

Introduction, benefits and limitations, procedure of EIA in India, impact identification, Ad hoc, checklists, matrices, networks and overlay, Description of affected environment, Prediction and assessment of impacts, Public participation in environmental decision making, Environmental monitoring and its importance, Environmental auditing.

References:

1. Barbara Caroll,. Environmental Impact Assessment Handbook: A Practical Guide for Planners, Developers and Communities. Thomas Telford, London 2002.
2. Canter, L.W.. Environmental Impact Assessment, (2e), McGraw-Hill 1996.
3. Christopher Wood.. Environmental Impact Assessment: A Comparative Review. Prentice Hall, New Jersey 2003.
4. Riki Therivel, Peter Morris,. Methods of Environmental Impact Assessment, Spon Press, London 2001.

CIE 4057: INDUSTRIAL WASTEWATER TREATMENT [3 0 0 3]

Industries and environment, Sources and types of industrial wastewater, Industrial wastewater and environmental impacts, Regulatory requirements for treatment of industrial wastewater, treatment of industrial wastewater, volume and strength reduction, Aerobic and anaerobic biological treatment, Sequencing batch reactors, High Rate reactors, Chemical oxidation, Photocatalysis, Wet Air Oxidation, Ion Exchange, Membrane Technologies, Nutrient removal, Management of treatment plants, Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet.

References:

1. Eckenfelder, W.W., Industrial Water Pollution Control, Mc-Graw Hill, 2000.
2. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001.
3. Paul L. Bishop, Pollution Prevention: - Fundamentals and Practice, Mc-Graw Hill International, Boston, 2000.
4. Nelson, L. Nemerow, Industrial wastewater Pollution, Addison-Wesley Publishing Company 2000.
5. Mahajan S.P Pollution Control in Process Industries, Tata McGraw Hill Publishing Company 1998

CIE 4058: SOLID WASTE MANAGEMENT [3 0 0 3]

Definition, Sources of wastes, classification, Characterization, Composition and Properties of solid Wastes, Waste generation Collection and transportation, Processing and recycling, Disposal: Methods, Landfills- types, design of landfills, operation of landfills, leachate generation, closure of landfill, monitoring of landfill, Siting of wastes management facilities: Siting guidelines, Planning and developing a site for solid waste management.

References:

1. Tchobanoglous, G., Theisen, H. and Vigil, S. A.. Integrated solid waste management, McGraw-Hill international edition, Civil Engineering Series. 1993
2. Bhide and Sundaresan,. Solid Waste Management in Developing Countries – Indian National Scientific Documentation Centre. New Delhi 2000.
3. Ramachandra T.V.. Management of Municipal Solid Waste, Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore 2006.

CIE 4059: DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES [3 0 0 3]

Bearing capacity- Brinch Hansen's, Meyerhoff's, Skempton's and Vesic's bearing capacity equations, Piles subjected to lateral loads-Broms theory, Sheet piles, Retaining walls- Cantilever and counterfort, Cofferdams, Well Foundation-Bearing capacity, Lateral stability, Foundations in expansive soils, Machine Foundations.

References:

1. Bowles J.E., Foundation Analysis and Design, McGraw Hill, New York, 1997
2. Winterkorn H.F and Fange H.Y., Foundation Engineering Hand book, Van Nostand Reinhold Company, New York. 1991
3. Teng W.C., Foundation Design, Prentice Hall of India, New Delhi, 1981.
4. Swami Saran., Analysis and Design of Substructures, (2e), Oxford and IBH Publishers, 2015
5. Srinivasalu P and Vaidyanathan C.V., Hand Book of Machine Foundations, Tata McGraw Hill, 1987.

CIE 4060: GEO-ENVIRONMENTAL ENGINEERING [3 0 0 3]

Introduction, Geoenvironmental Problems, Regulations and Practice, Composition and Properties of Soils and Wastes, Subsurface Flow and Contaminant Transport, Subsurface contamination, In-situ waste containment, Waste Containment Liner Systems, Leachate Collection and Removal Systems, Waste Containment System Liner Design, Final Cover Systems, Contaminated Site Investigation and Risk Assessment, Soil and Groundwater Remediation Technologies, Beneficial Use Of Waste Materials: Recycling, Case studies.

References:

1. Sharma, H.D. and Reddy, K.R., Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, John Wiley & Sons, Inc., . 2004.
2. Sharma, H.D. and Lewis, S.P., Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation, John Wiley & Sons, Inc, 1994.
3. Qian, X., Koerner, R.M., and Gray, D.H., Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, 2002.
4. Daniel, David E. Geotechnical Practice for Waste Disposal, Chapman & Hall, 1993.

CIE 4061: GROUND IMPROVEMENT TECHNIQUES [3 0 0 3]

Introduction to ground improvement techniques, Mechanical modification, Hydraulic modification, physical and chemical modification, Thermal modification, Modification by inclusions.

References:

1. M.R. Hausmann., Engineering Principles of Ground Modifications, (3e), McGraw Hill Publishing Co, 2002.
2. Moseley M.P., Ground Improvement, (2e), Blackie Academic and Professional, Boca Taton, Florida, USA, 2007.
3. Robert M. Koerner ., Designing with Geosynthetics, (2e), Prentice Hall New Jersey, USA, 2000
4. Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi, 2016.
5. Das.B.M., Principles of Foundation Engineering, CENGAGE Learning, 2010

CIE 4062: SOIL REINFORCEMENT AND GEOSYNTHETICS [3 0 0 3]

Introduction, Concept of reinforced soil, Different types of geosynthetics, Properties and tests on geosynthetics, Design of reinforced soil retaining walls, Design of reinforced earth foundations, Reinforced soil slopes, Soil nailing techniques, Pavement application, Drainage and filtration applications of geosynthetics, Construction of landfills using geosynthetics.

References:

1. Koerner. R.M., Designing with Geosynthetics, (5e), Prince Hall Publication, USA, 2005.
2. Sivakumar Babu G. L., An introduction to Soil Reinforcement and Geosynthetic, Universities Press, Hyderabad, 2009
3. Swami Saran, Reinforced Soil and its Engineering Applications, I. K. International Pvt. Ltd, New Delhi, 2006.
4. G.V. Rao, P.K Banerjee, J.T. Shahu,G.V. Ramana., Geosynthetics - New Horizons, Asian Books Private Ltd., New Delhi, 2004.
5. Jones CJEP, Earth reinforcement and Soil structures, Thomas Telford Publishing, London, 1996.

CIE 4063: DESIGN OF REINFORCED CONCRETE STRUCTURES [3 0 0 3]

Design of interior panel of flat slab with and without drops by direct design method. Design of Cantilever and Counter fort type retaining walls. Analysis and design of Single bay single story portal frame, and grid floor. Design of combined footing, strap footing and mat/raft foundation. Design of silos and bunkers.

References:

1. Unnikrishna Pillai., Devadas Menon., Reinforced Concrete Design, (3e), Tata McGraw Hill Publishing Company Limited, New Delhi.2009.
2. Shah H. J., Reinforced Concrete, Vol. II, (6e), Charotar Publishing House Pvt. Ltd., Anand, Gujarat. 2012.
3. Varghese P. C., Design of Reinforced Concrete Foundations, PHI Learning Private Limited, New Delhi.2010.
4. Varghese P. C., Advanced Reinforced Concrete Design, PHI Learning Private Limited, New Delhi.2011.
5. IS:456 – 2000, Code of practice for plain and Reinforced concrete, Bureau of Indian Standards, New Delhi
6. SP-16 – 1984, Design Aids for Reinforced concrete IS 456, Bureau of Indian Standards, New Delhi.

CIE 4064: DESIGN OF STEEL STRUCTURES [3 0 0 3]

Design of plate girders with stiffeners. Design of Gantry girders. Design of compression member subjected to combined axial and uniaxial bending, combined axial and biaxial bending for column sections. Design of flexural members for unsymmetrical bending. Axially loaded compression members of light gauge steel members, laterally supported beams in light gauge steel members. Introduction to Prefabricated steel structures and their applications.

References:

1. Duggal S.K., Limit State Design of Steel Structures, Tata McGraw Hill education private Limited – New Delhi. 2008.
2. Subramanian N., Design of Steel Structures, oxford university New Delhi, 2008.
3. IS 800-2007, General construction of steel in code of practice, Bureau of Indian Standards, New Delhi.
4. SP-6 (Part I) 1964, Structural Steel Sections, Bureau of Indian Standards, New Delhi.
5. IS 801-1975, Code of practice for use of cold framed light gauge steel, Bureau of Indian Standards, New Delhi.

CIE 4065: FINITE ELEMENT METHOD OF ANALYSIS [3 0 0 3]

General description of FEM. Theory of elasticity - constitutive relationships - plane stress and plane strain. Concept of an element, types of elements, displacement models by generalized coordinates, shape functions for different types of elements. Variational method of formulation - minimization of potential energy approach, formulation of element stiffness and consistent load vector for different types of elements. Application of FEM to analyze pin jointed and rigid jointed structures, plane stress and plane strain problems using three noded triangular element and isoparametric four-noded element.

References:

1. Zinkiewicz O.C., The Finite Element Method, (3e), Tata McGraw Hill Book Co, New Delhi, 1979.
2. Desai C.S. and Abel J.E., Introduction to the Finite Element Method, (1e), CBS publications, New Delhi, 1987.
3. Krishnamoorthy C.S., Finite Element Analysis, (2e), Tata McGraw Hill Publishing Company Ltd., New Delhi, 1987.
4. Bathe K.J., Finite Element Procedures in Engineering Analysis, (2e), Prentice Hall Engle Wood, Cliffs, New Jersey, 1997.

CIE 4066: PRESTRESSED CONCRETE DESIGN [3 0 0 3]

Basic Concepts of prestressing, Basic principles of prestressing, Load balancing concept, Material properties. Losses of prestress, Analysis of sections for flexure, shear. Design of simply supported pre-tensioned and post-tensioned members, Deflections, Transmission of pre-stress in pre-tensioned members, design of end zone reinforcement in post tensioned member. Analysis of Composite Sections for propped and unpropped condition.

References:

1. Krishna Raju N., Pre-stressed Concrete, (5e), Tata McGraw Hill, New Delhi, 2012.
2. Dayaratnam P., Pre-stressed Concrete Structures, (7e), Oxford and IBH Publications, New Delhi, 2017.
3. Mallick S. K. and Gupta A. P., Pre-stressed Concrete, (3e), Oxford and IBH, New Delhi
4. Lin T.Y. and Ned. Burns H., Design of Pre-stressed Concrete Structures, John Wiley and Sons, New York, 2017.

Code books:

1. IS:1343-2012, Code of Practice For Prestressed concrete, Bureau of Indian Standards, New Delhi.

CIE 4067: URBAN MASS TRANSPORT SYSTEM [3 0 0 3]

Introduction, Public Transport, Transit Network Planning, Transit Scheduling, Terminals and Depot, Transit Fares.

References:

1. Kristhi and Lal, Transportation Engineering, (3e), PHI, Delhi, 2008.
2. Dickey, J.W., et. al., Metropolitan Transportation Planning, TMH edition, 2002.
3. Vuchic V.R., Urban Public Transportation System and Technology, Prentice Hall,
4. Agarwal M.K., Urban Transportation in India, INAE, Allied Publishers Ltd., 1996.
5. Grey G.E. & Hoel, LA, Public Transportation Prentice Hall, Englewood Cliffs, N.J.

CIE 4068: URBAN TRANSPORT PLANNING [3 0 0 3]

Transportation Planning Process and Surveys, Trip Generation, Trip Distribution, Traffic Assignment, Modal Split, Land-use Transport Models.

References:

1. Kadiyali L.R., Traffic Engineering and Transportation Planning, (6e), Khanna Publisher, New Delhi.
2. Jotin Khisty C and Kent Lal B, Transportation Engineering-An Introduction, (3e), 2010, PHI, New Delhi,
3. Papacostas C S., Fundamentals of Traffic Engineering, Prentice Hall.
4. M.J.Bruton, Introduction to Transportation Planning - Hutchinson of London Ltd.
5. B.G.Hutchinson, Introduction to Urban System Planning -; Mc Gra Hill.

CIE 4069: PAVEMENT MATERIALS AND DESIGN [3 0 0 3]

Introduction, Design of Flexible pavement, Bituminous Materials, Design of Rigid pavement, Design of cement concrete mixes, Soil Stabilisation Roads, Design of Runway Pavement, Pavement Failure and Evaluation.

References:

1. Khanna S.K and Justo C.E.G., Highway Engineering, (10e), Nemchand and Bros., Roorkee 2015.
2. Dr Kadiyali L.R and Dr Lal N.B, Principles and Practices of Highway Engineering, (4e), Khanna Publisher, New Delhi 2003.
3. E.J. Yoder, Principles of Pavement Design, (2e), John Wiley & Sons, Inc. New York, 1975.
4. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003.

CIE 4070: TRAFFIC SYSTEMS AND ENGINEERING [3 0 0 3]

Traffic Engineering Studies, Traffic Flow Analysis, Design of Traffic Facilities, Road Accident Analysis, Design of Traffic Control System, Design of Road Lighting System.

References:

1. Papacostas C S., Fundamentals of Traffic Engineering, Prentice Hall, 1990.
2. Jotin Khisty C and Lall, Transportation Engineering, (3e), Prentice Hall, 2000.
3. Khanna S.K and Justo C.E.G., Highway Engineering - (10e), Nemchand and Bros., Roorkee 2015.

4. Kadiyali L.R., Traffic Engineering and Transportation Planning, (5e), Khanna Publisher, New Delhi 2000.

CIE 4071: INTEGRATED WATERSHED MANAGEMENT [3 0 0 3]

Watershed characteristics, watershed deterioration; Management plan, People's participation; Land Capability Classification, Capability ratings, improvements, land-use practices; Soil-Water-Plant relationship, Maintaining soil fertility, salinity, alkalinity, reclamation; Water Conservation methods for cropland, Small storage structures; Soil Erosion problems, Conservation method watershed approach; Waterlogging, preventive measures, Land drainage, Design & maintenance of drains.

References:

1. Watershed Management: Guidelines for Indian Conditions', by E. M. Tideman, Omega Scientific Publishers.
2. Hydrology and Soil Conservation Practices, by Ghanashyamdas Das, Prentice Hall, India.
3. Watershed Planning and Management, by Dr. Rajvir Singh, Yash Publishing House.
4. Watersheds – Processes, Assessment and Management, by Pau A. Debarry, John Wiley and Sons.
5. Watershed Models, by V. P. Singh and Donald K. Frevert, Taylor & Francis.

CIE 4072: HYDRAULICS & HYDRAULIC MACHINES [3 0 0 3]

Fundamentals of Open Channel Flow, Gradually Varied Flow, Rapidly Varied flow, Design of Stable Channels, Impulse Momentum Principle and Its Applications, hydro power plants, Hydraulic turbines, classification of turbines, general Principles of working of Pelton, Francis and Kaplan turbines, Hydraulic Pumps, Classification, work done and efficiencies, pumps in series and pumps in parallel, specific speed, Reciprocating Pumps.

References:

1. VenTe Chow, Open Channel Flow, McGraw Hill Company Ltd., New York, 1985
2. Subramanya K., Flow in Open Channels, Tata McGraw Hill Publishing Company, New-Delhi, 2005
3. Modi P.N. and Seth S.M, Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 2005
4. Bansal R. K. Fluid Mechanics and Hydraulic Machines, Laxmi Publishers, New Delhi. 2010

CIE 4073: HYDROLOGICAL ANALYSIS [3 0 0 3]

Introduction, Hydrological cycle, Analysis of precipitation data, Abstractions, Runoff, Hydrographs, Unit hydrograph, S-curve, Synthetic unit hydrograph- Snyder's method, Floods, Empirical methods, rational method, Envelope curves, Flood frequency methods, Flood routing.

References:

1. Linsley, Pauler and Kohlas, Hydrology for Engineers, MGH Publishers, Tokyo. 1975
2. Linsley, Kohler & Paulhus, Applied hydrology, MGH Publications, New York. 1949
3. VenTe Chow, D. R. Maidment, L.W. Mays, Applied Hydrology, McGraw Hill. 1998
4. H. M. Raghunath, Hydrology, Wiley Eastern publications, Delhi, 1985
5. W. Viessman & J. Knapp "Introduction to hydrology", Harper & Row publishers. 1989

CIE 4074: WATER RESOURCES PLANNING & MANAGEMENT [3 0 0 3]

Capability & requirements of multipurpose projects, steps involved in planning, common pitfalls. Data collection importance, storage, retrieval; Extrapolation of data, Simulated data, Conjunctive-use management; Reservoir Planning & Operation, Reservoir capacity, Yield determination, Demand patterns, Optimal reservoir operation, Rule curves; Canal Management Need & Inadequacies, Planning canal systems, Canal regulation; River Training methods & structures; Economics Of Water Resource Projects, Cost-Benefit analysis, Apportionment of total cost, Economic & Financial efficiency, Project selection; Socio-Legal & Environmental Aspects Riparian rights, Environmental aspects, Sustainable development.

References:

1. Loucks, D.P and Eelco van Beek. Water resources systems planning and management: An introduction to methods, models and applications, UNESCO. 2005
 2. Vedula, S. and Mujumdar, P.P. Water resources systems: Modeling techniques and analysis, Tata McGraw Hill, New Delhi 2005.
 3. Mays, L.W. and Tung, Y.K.. Hydro systems engineering and management, McGraw Hill, USA 1992.
 4. Simonovic, S.P. Managing water resources: Methods and tools for a systems approach, UNESCO publishing, France 2009.
- Jain, S.K. and Singh V. P. Water Resources Systems Planning and Management, Elsevier 2003.

CIE 4075: BRIDGE ENGINEERING [3 0 0 3]

Investigation for bridge, Site selection, data drawing, design discharge linear water way, Standard specification for Road Bridge as per IRC Bridge code, load calculation, Design of pipe Culverts, Concrete Bridges-Types, components and Design of T beam reinforced concrete bridges, Pre stressed concrete bridges, Continuous bridges, cantilever bridges, Design of Sub structure- Piers and Abutments, Caissons, scour, bridge bearings, wing walls.

References:

1. T RJagadeesh, M A Jayaram, Design of Bridge Structures, PHI Learning Private Limited, 2009
2. Ponnusamy S, Bridge Engineering Tata McGraw Hill Publishing Co., New Delhi, 2008
3. Whitney, C.S, Bridges, Greenwich House, 1983
4. N.K.Raju, Design of bridges, Oxford & IBH Publishing Co. Pvt. Ltd.
5. Indian Road Congress Codes No.5, 6, 18, 21, 24, Jamnagar House, Shah Jahan Road, New Delhi

CIE 4076: COASTAL ENGINEERING [3 0 0 3]

Introduction to coastal engineering, Origin of coasts, Coastal process, wind, waves, Coastal erosion and Coastal protection work, littoral drift, Seawalls and bulkheads, Groins, Jetties, off-shore breakwaters, artificial beach nourishment, Environmental impact assessment, Port Planning, Harbour structures: Berthing structures, Breakwaters: types.

References:

1. Dominic Reeve, Coastal Engineering, (3e), CRSC press, 2018
2. S. Narasimhan, S. Kathirolu, Nagendra Kumar B, Harbour and coastal Engineering, Volume I & II, National Institute of Ocean Technology, NIOT, Chennai, Ocean and Coastal Engineering Publications, 2002.
3. William kamphuis J, Introduction to coastal engineering and management, (2e), world scientific publishing company, 2009.
4. Robert M Sorensen, Basic coastal engineering, (3e), Springer publication, 2005.

5. Coastal Engineering Manual (CEM), U.S.Army Corps of Engineer, Vicksburg, Miss, 2012.
6. Brunn P., Port Engineering Gulf, publishing Company, 1981.

CIE 4077: CONTRACT MANAGEMENT [3 0 0 3]

Introduction to contracts, Types of contracts, Tendering process, Dispute resolution, Conciliation, International contracts / contracts with international funding: International Competitive Bidding, Domestic Preference, FIDIC Documents, Conditions, Currency of Bid and Payment, Escalation in Foreign Currency, Financing of projects, Applicable Law and Settlement of Disputes, International Arbitration.

References:

1. Prakash V. A., Contracts Management in Civil Engineering Projects, NICMAR 1997
2. Patil B. S., Civil Engineering Contracts and Estimates, University Press. 2009
3. John G. Betty, Engineering Contracts, McGrawHills., 1993
4. Vasavada B. J Engineering Contracts and Arbitration, (Self Publication by Jyoti B. Vasavada). ,1997
5. Albett Robert W., Engineering Contracts and Specifications, John Willey and Sons, New York. 1961
6. Vaid K.N., Global perspective on International Construction Contracting Technology and Project Management, NICMAR, Mumbai. 1998

CIE 4078: ELEMENTS OF EARTHQUAKE ENGINEERING [3 0 0 3]

Introduction, seismic zoning map of India, seismic waves, seismograms, earthquake magnitude and intensity, Introduction to theory of vibrations, Primary and secondary effects of earthquake, Lesson learnt from the past earthquakes, Equivalent static method (IS 1893), Ductile detailing of RC frames as per IS 13920 (1993), Restoration and retrofitting of existing structures

References:

1. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice-Hall of India Private Limited, New Delhi, 2006
2. Murty, C.V.R, Earthquake Tips- Learning Earthquake Design and Construction, National Information Centre of Earthquake Engineering, IIT Kanpur.2005
3. Varghese. P. C., Advanced reinforced concrete design, Prentice-Hall of India Private Limited, New Delhi. 2005
4. Chopra A.K., Dynamics of Structures, Prentice Hall of India Pvt. Ltd. New Delhi.1996
5. IS:1893 (part 1)- 2002, "Criteria for earthquake resistant design of structures", Bureau of Indian Standards, New Delhi
6. IS: 13920 – 1993, Ductile detailing of reinforced concrete structures subjected to seismic forces- code of practice, Bureau of Indian Standards, New Delhi

CIE 4079: FECAL SLUDGE AND SEPTAGE MANAGEMENT

Introduction to sanitation at global, national, state and ULB situation, Components of FSSM such as characterization, collection, transportation and treatment etc., Technology Options such as technology systems end use, case studies, design, FSM plan, etc., Governance institutional, regulatory mechanism and finance, policy, regulation, Act, programme, scheme etc., Case studies.

References:

1. Guidelines for Septage management in Maharashtra, 2016
2. Guidelines for ULB to implement Septage management in

Maharashtra, 2016

3. A toolkit on IFSN prepared by National Institute of Urban Affairs, 2016

CIE 4080: NONDESTRUCTIVE TESTING OF CONCRETE STRUCTURES [3 0 0 3]

Introduction, visual Inspection Technique, Half-Cell Electrical Potential Method, Schmidt Rebound Hammer Test, Carbonation Depth Measurement Test, Penetration Resistance or Windsor Probe Test, Resistivity Measurement, Electromagnetic Methods of Testing Concrete, Radiographic Testing, Ultrasonic Testing, Ground Penetrating.

References:

1. J.H.Bungey, The Testing of Concrete in Structures, (4e), Surry University Press, 2006.
2. Guidebook on Non-Destructive Testing Of Concrete Structures, Training Course Series No. 17, International Atomic Energy Agency, Vienna, 2002.
3. Christiane Maierhofer, Hans-Wolf Reinhardt and Gerd Dobmann, Non-Destructive Evaluation of Reinforced Concrete Structures, Vol. 1 & 2, (1e), Woodhead Publishing Limited, 2010.
4. V.M. Malhotra and N.J. Carino, Handbook on Nondestructive Testing of Concrete, 2nd, CRC Press, 2003.

CIE 4081: REMOTE SENSING AND GIS [3 0 0 3]

Introduction, Basic concepts of Remote sensing, Physics of Remote sensing Orbits, Concept of Spatial, spectral, radiometric and temporal resolution, Visual interpretation, basics of Digital Interpretation of images, application of Toposheet in base map preparation, Fundamentals of GIS, Objectives, Components of GIS, contributing disciplines and technologies, Raster, Vector, Definitions of Triangular irregular network (TIN) and Digital Elevation Model (DEM), Indian satellite program, Launch vehicles, Exercise on Remote sensing and GIS applications in Civil Engineering

References:

1. Lillesand T. M., and Kiefer, R.W. Remote Sensing and Image interpretation, (6e), of John Wiley & Sons 2000
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, (2e), 1995
3. Sabins, F. F. Jr, "Remote Sensing Principles and Image interpretation", W. H. Freeman & Co. 1978
4. Allan Brimicombe, "GIS Environmental Modeling and Engineering", Taylor & Francis, 2003

OPEN ELECTIVES

CIE 4301: AIR AND NOISE POLLUTION [3 0 0 3]

Definition, sources, classification, Behavior of air pollutants, Meteorological variables, stability conditions, plume rise and stack height, Effects of air pollution, Sampling, analysis and control, Global effects of air pollution, Noise Pollution, Air and noise legislations

References:

1. Rao H.V.N. and Rao M.N, Air pollution, Tata Mc Graw Hill, New Delhi 1989.
2. Rao C.S., Environmental Pollution contro, Wiley Eastern Ltd. Delhi.1995.
3. Wark Kenneth and Wamer C.F, Air Pollution its Origin and Control. Harper and Row, Publ.
4. Sincero. A. Pand Sincero G.A. Environmental Engineering. Prentice Hall.
5. Air Pollution - Sampling and Analysis - APHA.

CIE 4302: CONTRACT MANAGEMENT FOR ENGINEERS [3 0 0 3]

Introduction to contracts, Types of contracts, Tendering process, Dispute resolution, Conciliation, International contracts / contracts with international funding: International Competitive Bidding, Domestic Preference, FIDIC Documents, Conditions, Currency of Bid and Payment, Escalation in Foreign Currency, Financing of projects, Applicable Law and Settlement of Disputes, International Arbitration.

References:

1. Prakash V. A., Contracts Management in Civil Engineering Projects, NICMAR 1997
2. Patil B. S., Civil Engineering Contracts and Estimates, University Press 2009.
3. John G. Betty, Engineering Contracts, McGraw Hills 1993
4. Vasavada B. J. Engineering Contracts and Arbitration, (Self Publication by Jyoti B. Vasavada) 1997.
5. Albett Robert W., Engineering Contracts and Specifications, John Wiley and Sons, New York. (1961)
6. Vaid K.N., Global perspective on International Construction Contracting Technology and Project Management, NICMAR, Mumbai. 1998

CIE 4303: ENVIRONMENTAL MANAGEMENT [3 0 0 3]

Overview of the state of the global environment, the earth's natural systems, sustainability and sustainable development, environmental management system (EMS), Environmental Ethics, Laws, International Environmental Legislation, Life Cycle Assessment Components of LCA, ISO 14000 series, Auditing, Environmental Economics and environmental design-application.

References :

1. Ramachandra.T.V, Environmental Management, IISC Bangalore 2012
2. Lohani B.N., Environmental Quality Management, South Asian Publishers, New Delhi. 1984
3. MOEF, Government of India, Carrying Capacity Based Developmental Planning Studies for the National Capital Region, 1995-96.
4. Chanlett, Environmental Protection, McGraw Hill Publication, New York. 1973
5. Environmental Laws-MOEF, Government of India

CIE 4304: GEOLOGY FOR ENGINEERS [3 0 0 3]

Introduction, Physical Geology: Origin of Earth, Interior structure of Earth. Seismology, Plate Tectonics, Earthquakes. Tsunamis. Introduction to minerals and rocks. Engineering properties of important rocks. Weathering of rocks, Soil forming processes. Landforms and processes associated with river, wind, and groundwater. Structural Geology, Groundwater, Engineering Geology, Landslides, Remote sensing & GIS and their applications, Geophysical methods –Seismic and electrical methods for subsurface investigations, engineering solutions to control climate change.

References:

1. Parbin Singh, Engineering Geology, S.K. Kataria and Sons, New Delhi. 2002
2. Mukherjee P.K., A text book of Geology, World Press, Kolkata 2003
3. Venkata Reddy D., Engineering Geology for Civil Engineering, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1995

CIE 4305: INTRODUCTION TO REMOTE SENSING AND GIS [3 0 0 3]

Introduction, basic concepts of remote sensing, orbits, concepts of spatial, radiometric and temporal resolution, Remote sensing data product and its purchase, visual interpretation, Fundamentals of GIS, Components of GIS, Raster and Vector Images, Remote sensing an GIS

application, Triangular Irregular Network (TIN) and Digital elevation models (DEM), In-class GIS Lab.

References:

1. Remote Sensing and Image Interpretation – Lillesand, Kiefer and Chipman
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, (2e), 1995
3. Sabins, F. F. Jr, Remote Sensing Principles and Image interpretation, W. H. Freeman & Co 1978
4. Allan Brimicombe, GIS Environmental Modeling and Engineering, Taylor & Francis, 2003

CIE 4306: STRENGTH OF MATERIALS [3 0 0 3]

Introduction, basics of Mechanics of Solids. Shear force diagram and bending moment diagram for statically determinate beams, Stresses due to bending, stresses due to shearing force. Slope and deflection of beams. Torsion, solid and hollow circular shafts, power transmitted by shafts. Variation of stress at a point, Bi-axial state of stress and strain. Stability of columns, Slenderness ratio, failure by buckling, Euler's formula, Rankine's empirical formula.

References:

1. Basavarajaiah B.S, amd Mahadevappa P, Strength of Materials, University Press (India) Pvt. Ltd., 2010.
2. Ferdinand P. Beer, E. Russell Johnston and Jr. John T. D., Mechanics of Materials, (3e), Tata McGraw-Hill.
3. Andrew Pytel, Singer F. L., Strength of Materials Harper & Collins 1987.
4. Young D. H, Timoshenko S.P, Elements of Strength of Materials, East West Press Pvt. Ltd., 2014.
5. Bansal R.K., A Textbook of Strength of Materials, Laxmi Publications, 2014.
6. Rattan S.S., Strength of Materials McGraw Hill Education (India) Pvt. Ltd., 2013.



OPEN ELECTIVES

MCA 4301: INTRODUCTION TO DATABASE SYSTEMS WITH MYSQL [3 0 0 3]

Modeling and Designing Databases, Database Design Process, Entity-Relationship Model, Basic Concepts, Constraints, Design of ER database schema, Reduction of ER to schema, Relational model, Super, candidate, primary, foreign key, Schema Diagram, Relational Database design, Functional dependencies, Normal forms, Creating a MySQL Database, Table, Modifying table, constraints, indexes, Basic SQL, Inserting Data, Selecting Data, Updating Data, Deleting Data, MySQL Functions, Numeric, String, Date /Time, Advanced Queries, Sorting, Multiple tables, Inner Join, Left Join, Right Join, Natural Join, Nested queries, Generating summaries, COUNT(), MIN(), MAX(), SUM(), AVG(), Group By, Statistical techniques, Calculating Descriptive statistics, Per-Group Descriptive Statistics, Generating frequency distribution, Calculating correlation coefficients, assigning ranks, Stored routines, stored procedure, stored function, Triggers, Events to schedule Database actions, Managing users and privileges, Importing and Exporting data, importing data with LOAD data and mysql import, importing csv files, exporting query results, tables, importing XML.

References:

1. Paul Dubois, MySQL Cookbook, O'REILLY, First Edition, 2007.
2. Larry Ullman, Visual Quick Start guide MySQL, Pearson Education, 2nd Edition, 2007.
3. Seyed M. M, Saied Tahaghoghi and Hugh Williams, Learning MySQL, O'Reilly, 2006.
4. Russell J.T. Dyer, MySQL in a Nutshell, O'REILLY, 2nd Edition, 2008.

MCA 4302: INTRODUCTION TO VR AND AR TECHNOLOGIES [3 0 0 3]

Introduction: Input Devices, Output Devices, Displays, Computing Architectures for VR, The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures, Modeling, Geometric Modeling, Physical Modeling, Behavior Modeling, Model Management, VR Programming and other Toolkits. Introduction to Unity 3D Engine, 2D Game concepts and basic scripting, 3D Game concepts and environment creation, Advanced game concepts. Introduction to Unity AR: Foundation and Vuforia, working with Vuforia in Unity, ARCore in unity, Mini project on AR. Introduction to VR, Unity for Google cardboard, Basic VR app development for Cardboard, Develop for a specific VR platform.

References:

1. Jonathan Linowers, Krystian Banbilinski, Augmented Reality for Developers, Packt Publishers, 2017.
2. Edward Lavieri, Getting started with Unity 5, Packt publishing, 2015.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley-IEEE Press, 2003.
4. Sherman, W.R. & A. Craig, Understanding, Virtual Reality: Interface, Application and Design, Morgan Kaufmann, San Francisco, CA, 2003.
5. Philippe Fuchs, Guillaume Moreau, Pascal Guitton, Virtual Reality: Concepts and Technologies, CRC, Taylor and Francis, 2011.

MCA 4303: INTRODUCTION TO LINUX AND SHELL SCRIPTING [3 0 0 3]

Introduction to UNIX/LINUX Operating System: OS concepts, Linux overview, key features of Linux, pros and cons of Linux. Processes: Processes and Files, I/O redirection and pipes, process creation, process attributes standard process file descriptors. File and Process

commands. File systems: Files and directories, file naming and wildcards, file attributes, file permissions. Regular Expressions & filters: find, grep, cut, sort, grep patterns. AWK and SED. Shell and Shell Scripting: The need for shell, types of shells, interactive uses of shell, using shell for creating user commands, functions. Bash shell features: Statements, data structure, built-in commands, environment customization primitives. Linux Editors.

References:

1. Richard Blum and Christine Bresnahan, Linux Command Line Shell Scripting BIBLE, 3rd Edition, Wiley, 2015.
2. Mark Sobel. A Practical Guide to Linux commands Editor and shell programming, Prentice Hall, 2nd Edition, 2010.
3. Stephen G. Kochan. Unix Shell Programming, 3rd Edition, SAMS Publications, 2003.
4. Bash Reference Manual Download able from GNU Project.
5. Brian W Kerningham and Rob Pike. The Unix Programming Environment, PHI Learning Pvt. Ltd., 2009.

MCA 4304: INTRODUCTION TO DATA ANALYTICS [3 0 0 3]

Introduction - data science, need for analytics, steps in data analysis projects, Data- sources of data, data sets, data warehouses, data types, privacy and confidentiality, samples vs. population. Data summarization and visualization – tables and graphs. Data Preprocessing- cleaning, transformation, dimensionality reduction. Data Analysis and Visualization – descriptive, inferential statistics, uni-variate and multi-variate analysis. Grouping – Cluster Analysis- distance measures, partitioning, hierarchical, density based methods. Market Basket Analysis, Association Analysis, Market Basket Analysis. Classifiers- Bayesian, k-nearest neighbor, neural network, Support Vector Machine, Decision Trees. Prediction- Regression models, Evaluating Classification and Predictive performance, ensemble methods. Anomaly Detection. Forecasting models.

References:

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
3. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Intelligence, John Wiley & Sons, 2014.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2011.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley, 2005.

Minor Specialization: Computational Mathematics

MAT 4051: APPLIED STATISTICS AND TIME SERIES ANALYSIS [2 1 0 3]

Stochastic and deterministic dynamic mathematical models – forecasting and control, transfer function models, models for discrete control systems. Basic ideas in model building- linear and multiple linear regression. Basic concepts in stochastic processes and Markov chains, Mean square distance, mean square error prediction, prediction of covariance stationary process, ergodic theory and stationary process, applications of ergodic theory, spectral analysis of covariance stationary processes, Gaussian systems, stationary point processes, level crossing problems. ARIMA models, Autoregressive models, moving average models, duality, model properties, parameter estimates, forecasts. Volatility models: ARCH and GARCH modelling, testing strategy for heteroscedastic models, volatility forecasts, Black Scholes model.

References:

1. G.E.P.Box, G. M. Jenkins, G. C. Reinsel and G M Ljung, *Time Series Analysis-Forecasting and Control*, (5e), Wiley Series, 2016.
2. Anderson T W, *The Statistical Analysis of Time Series*, John Wiley, New York, 1994
3. Samuel Karlin, Howard M Taylor, *First Course in Stochastic process*, Academic Press, New York,
4. C. Chatfield, *The Analysis of Time Series – An Introduction*, Chapman and Hall / CRC, (4e), 2004
5. David Ruppert, *Statistics in Finance*, Springer Publications, 2004

MAT 4052: COMPUTATIONAL LINEAR ALGEBRA [2 1 0 3]

Matrix Analysis: Basic Ideas from Linear algebra, vector norms, matrix norms, orthogonality and SVD, Projections and CS decomposition, the sensitivity of square linear systems. General Linear Systems: Triangular systems, The LU factorization, Round off analysis of Gaussian elimination, Pivoting, Improving and estimating accuracy. Orthogonalization and least squares: Householder and Givens matrices, The QR factorization, The full rank LS problem, Other orthogonal factorizations, The rank deficient LS problem, Weighing and iterative improvement, square and underdetermined systems. The symmetric Eigen value problem: Eigen values properties and decompositions, Power iterations, the symmetric QR algorithm, Jacobi methods, Tridiagonal Methods, Computing the SVD, some generalized eigen value problems.

References:

1. Gene H. Golub and Charles F. Van Loan, *Matrix Computations*, (4e), Johns Hopkins University Press, 2013.
2. Gilbert Strang, *Linear Algebra and its applications*, (4e), Wellesley Cambridge press, 2009.
3. David S. Watkins, *Fundamentals of Matrix Computations*, (3e), Wiley, New York, 2010.
4. Roger a Horn, *Matrix Analysis*, (2e), Cambridge University Press, 2013.

MAT 4053: COMPUTATIONAL PROBABILITY AND DESIGN OF EXPERIMENTS [2 1 0 3]

Sampling and sampling distributions, Most powerful tests, Uniformly most powerful tests, Likelihood ratio tests, The sequential probability ratio test, Randomized Designs, Inferences about the differences in Means, Paired Comparison Designs, Inferences about the variance of normal distributions, Monte Carlo estimation methods. The analysis of variance, RCBD, LSD and Related Designs, The Graeco - Latin square Design, Balanced Incomplete Block Designs, PBIBD Introduction to Factorial Designs, The Two Factor factorial design, Blocking in a factorial

design, 2^k Factorial Design, Blocking and Confounding in the 2^k Factorial Design, Partial Confounding. Two level fractional factorial designs, three level and mixed level factorial and fractional factorial designs, 3^k Factorial Design, Confounding in the 3^k Factorial Design, Fractional replication of the 3^k Factorial Design, Factorials with mixed levels.

References:

1. Robert V Hogg and Allen Craig, *Introduction to Mathematical Statistics*, (4e), Macmillan
2. M N Murthy, *Sampling Theory and Methods*, Statistical Publishing Society, 1967
3. C Radhakrishna Rao, *Linear Statistical Inference and its applications*, (2e), Wiley Series.
4. Douglas C Montgomery, *Design and Analysis of Experiments*, (8e), Wiley Series, 2012,
5. D D Joshi, *Linear Estimation and Design of Experiments*, New Age International Publishers, 2009

MAT 4054: GRAPHS AND MATRICES [2 1 0 3]

Graphs and subgraphs, walks, paths and connectedness, distance as a metric, degrees, regular graphs, cubic graphs, bipartite graphs, self-complementary graphs, operations on graphs, extremal graphs, cut points, bridges and blocks, block graphs and cut point graphs. Trees and their characterizations, centres and centroids, block-cut point trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, graphical variations of Menger's theorem. Traversability: Eulerian graphs and Hamiltonian graphs. Line graphs and total graphs. Line graphs and traversability, coverings and independence, critical points and lines. Planarity: Plane and planar graphs, outer planar graphs, Kuratowski's theorem, vertex colouring. Incidence Matrix: Rank, minors, path matrix, 0-1 incidence matrix. Adjacency Matrix: Eigen values of some graphs, determinant, bounds, energy of a graph, antiadjacency matrix of a directed graph, non-singular trees. Laplacian Matrix: Basic properties, computing Laplacian eigen values, matrix tree theorems, bounds for Laplacian spectral radius, edge-Laplacian of a tree.

References:

1. F. Harary, *Graph Theory*, Narosa Publishers, 1988.
2. J.A Bondy and U.S.R Murthy, *Graph Theory with Applications*, (5e), Elsevier Publishing Co., 1982.
3. D.B. West, *Introduction to Graph Theory*, Pearson Education, Inc., 2001.
4. R.B Bapat, *Graphs and Matrices*, Hindustan Book Agency, 2010.
5. Lowell W Beineke and Robin J Wilson, *Topics in Algebraic Graph Theory*, Cambridge University Press, 2005.

OPEN ELECTIVES

MAT 5301: APPLIED GRAPH THEORY [2 1 0 3]

Graphs and applications of the theorems by Havel and Hakimi, Erdos and Gallai. Cut points, bridges and blocks, block graphs and cut point graphs. Trees and their characterizations, centre and centroids, block-cut points trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, Whitney's theorem. Traversability-Eulerian, Hamiltonian, line graphs and total graphs. Traversability, coverings and independence, theorem of Gallai, critical points and lines. Planarity, genus, thickness, crossing number. Colorability, chromatic number and its bounds, Nordhaus Gaddum theorems, the four and five colour theorems, chromatic polynomial. Matrix Representation -Incident matrix, Adjacency matrix, cycle matrix, cutset matrix, path matrix, Digraphs, Matrix - tree theorem on number of spanning trees. Tournament. Graph theoretic Algorithms: Computer representation of graphs-Input and output, Algorithms for connectedness, Spanning Tree, Fundamental Circuits, Directed Circuits and Shortest paths.

References:

1. F. Harary, *Graph theory*, Narosa Publishers
2. Narsingh Deo, *Graph theory with applications to Engineering and Computer Science*, Prentice Hall.
3. Robin J. Wilson, *Introduction to Graph theory*, Logman

MAT 5302: APPLIED LINEAR ALGEBRA [2 1 0 3]

Finite dimensional vector spaces, subspaces, linear independence, basis and dimension. Sum and intersection of subspaces. Algebra of linear transformations, range and null space of a linear transformation, Inner-product spaces, metric spaces and Banach spaces, Gram Schmidt orthogonalization, linear operators and their adjoint, self adjoint, unitary and normal transformations, polar decomposition. Matrix algebra, simultaneous equations, Eigen values, characteristic vectors, Cayley-Hamilton theorem, minimal polynomial, Application of eigen values to solve simultaneous difference and differential equations. Quadratic forms and their classification, constrained optimization. Some computational methods of linear algebra.

References:

1. Gantmacher F.R., *The Theory of Matrices*, Chelsea.
2. Gilbert Strang, *Linear Algebra and its applications*, Thomson Learning
3. David C. Lay, *Linear Algebra and its applications*, Pearson Education

MAT 5303: APPLIED NUMERICAL METHODS [2 1 0 3]

Matrix Algebra : Solution for linear system of equations – Direct methods: Gauss elimination method, Gauss Jordan method, Crout's (LU decomposition) method. Iterative methods, Jacobi Gauss Seidel and successive over relaxation methods. Computation of inverse of a matrix: Jordan method, Triangularization method, Choleski's method, partition method. Eigen value & Eigen vectors: Given's method for real symmetric matrices, Jacobi's method for real symmetric matrices, Power method. Numerical Solution of Ordinary Differential Equations: Single step methods, Runge- Kutta method, Adam Bashforth's predictor corrector method, Milne's predictor and corrector method. Numerical Solution of Partial Differential Equations: Finite difference approximation to derivatives of Parabolic, Elliptic. Explicit finite difference method, implicit method.

References:

1. Jain, Iyengar and Jain: *Numerical methods for Scientific and Engineering Computations*, New Age Publishers
2. Carnahan, Luther and Wikes: *Applied Numerical Methods*, John Wiley
3. Conte S.D and Be Door, *Introduction to Numerical analysis*, McGraw Hill.

MAT 5304: MATHEMATICAL MODELLING [2 1 0 3]

Introduction, Techniques, classification and characteristics of mathematical models, mathematical modeling through algebra, ordinary differential equations of first order. Mathematical modeling through systems of ordinary differential equations of first order, Prey- Predator model Mathematical modeling through systems of ordinary differential equations, modeling in medicine A model for diabetic mellitus. Modelling

on population dynamics Mathematical modelling through difference equations. Some simple models. Modelling of economics and finance through difference equations, population dynamics and generation of models through difference equations, modeling in probability theory, examples. Optimization models: Mathematical modeling through linear programming. Mathematical modelling through graphs: elements of graphs, digraphs. Mathematical models for blood flow. Mathematical model for Peristaltic transport of two layered.

References:

1. J N Kapur, *Mathematical Modelling*, New age international publishers, (2e), 2015.
2. J N Kapur *Mathematical Models in biology and medicine*, East- West press.
3. J N Kapur *Mathematical models of environment*, INS Academy, New Delhi

MAT 5305: OPTIMIZATION TECHNIQUES [2 1 0 3]

Formulation, Linear programming-simplex method, Penalty coarse methods, 2-phase method. Dual Simplex method. Duality theory. Transportation problem-Vogel's approximation method, MODI method, Assignment problem-Hungarian method. Project Management - Networks, Project planning and control using PERT and CPM. Project crashing. Game theory - 2 persons zero sum games, Minimax principle, games with mixed strategies. Dominance theory, solution using Linear programming.

References:

1. Bronson Richard - *Theory and Problems of Operations Research*- Schaum series- MGH
2. P.K. Gupta & Man Mohan - *Operations Research* - Sultan Chand & Sons
3. Hamdy A. Taha - *Operations Research* PHI

MAT 5306: STOCHASTIC PROCESSES AND RELIABILITY [2 1 0 3]

Static probabilities: Review and prerequisites generating functions, difference equations. Dynamic probability: definition and description with examples. Markov chains, transition probabilities, Chapman Kolmogorov equations. Classification of states, chains of Markov process. Stability of Markov systems, limiting behaviour, random walk. Poisson Processes : assumptions and derivations, related distributions, birth and death processes. Queueing System, general concepts, Model M/M/1 and M/M/S, steady state behaviour, transient behaviour. Wiener processes and Gaussian processes. Differential equations of a Wiener process, Kolmogorov equations, Ornstein – Ulmerbeck Process. White noise. Reliability Theory : Definition of Reliability, types of failure, Hazard rate, Laws of failure - normal, exponential & Weibull failure laws - System reliability - in series, in parallel series - parallel system, Parallel - series system & related problems.

References:

1. Medhi. J., *Stochastic Processes*, Wiley Eastern.
2. Bhat U R, *Elements of Applied Stochastic Processes*, John Wiley.
3. A Papoulis, *Probability, Random Variables and Stochastic Processes*, McGraw Hill.

Minor Specialization: Business Management

HUM 4051: FINANCIAL MANAGEMENT [2 1 0 3]

Introduction and objectives of financial management, Evolution of corporate finance, responsibilities. Types of accounts, Golden rules of accounting, Preparation of Journal, Ledger, Trial balance and final accounts. Sources of long term finance, Characteristics of equity capital, Preference capital, Debenture capital & Term loans. Valuation of securities, Concepts, Bond valuation and related models, Bond value theorems, Yield to maturity. Equity valuation; Dividend capitalization approach, Leverage, Operating leverage, Financial leverage, Total leverage, Indifference point analysis. Working capital management, Capital budgeting: appraisal criteria, pay-back period, Average rate of return, Net present value, Benefit cost ratio and Internal rate of return. Risk analysis in capital budgeting, Cost of capital: introduction, cost of debt capital, Preference capital and Equity capital, Weighted average cost of capital, Determination of proportions, Cash management, Dividend decisions.

References:

1. Prasanna Chandra., Fundamentals of Financial Management, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2006.
2. I M Pandey, Financial Management, Vikas Publishing House Pvt Ltd., New Delhi, 2015.
3. N Ramachandran & Ram Kumar Kakani, Financial Accounting for Management, 3/e, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2011.
4. Eugene F Brigham & Michael C E, Financial Management: Theory and Practice. 12e, Cengage Learning, India, 2008.
5. Maheshwari S.N., Financial Management, Sultan Chand & Co., New Delhi, 2002.

HUM 4052: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

Introduction, Scope of HRM, Objectives of HRM, Functions, Activities, Roles, HRD organization and responsibilities. Evolution of HRM, Influence of various factors on HRM. Human resource planning: Introduction, Strategic considerations, Nature and scope, Human Resources Inventory, Job analysis, Job design, Job description, Job specification and Job evaluation. Employee Recruitment & Selection: Policy, Process, Tests, modern methods, Interview, Provisional selection, Medical/Physical examinations, Placement, Induction programs and socialization. Training and development: Basic concepts, Employees training Process, Planning, Preparation of trainees, Implementation, Performance evaluation and Follow-up training. Competency Mapping and Career development programmes. Performance appraisal and Merit rating, Promotion, transfers and separations, Wages and salaries administration, Discipline and grievances. Industrial and labour relations and Trade Unionism Overview: Collective bargaining and maintaining Industrial health.

References:

1. Michael Armstrong ., A Handbook of Human Resource Management Practice: 10th Edition, New Delhi, Kogan Page India, 2006
2. Gary Dessler & Biju Varkey ., Human Resource Management: 12th Edition Dorling Kindersley (India), Noida, 2011
3. T.V. Rao and Pereira D F., Recent experiences in Human Resources Development, Oxford and IBH Publishing, 1986.
4. Subbrao A., Essentials of Human Resource Management and industrial Relations, Himalaya Publishing House, 1999.
5. Aswathappa K, Human Resource Management, Text & Cases McGraw Hill 7th Edition, 2006
6. N G Nair and Latha Nair., Personnel Management and Industrial Relations, S. Chand Company, 1995.

HUM 4053: MARKETING MANAGEMENT [2 1 0 3]

Marketing definition, scope and concepts, Adapting marketing to the New Economy, Marketing strategic planning. Market Demand, Marketing Environment, Marketing Information System, Marketing Research. Segmentation, Targeting and Positioning, Buying Behaviour: Consumer Markets and Business Markets, Competition: Identifying competitors, analysing competitors. Product Life Cycle: Product life-cycle marketing strategies. New Market Offerings: New product development and challenges, Branding. Designing and Managing Services, Price Strategies, Retailing, Wholesaling, Integrated Marketing Communications, Digital Marketing and Trends, International Marketing

References:

1. Philip Kotler, Kevin Keller, Abraham Koshy & Mithileshwar Jha, Marketing Management – A South Asian Perspective, Pearson Education Inc, New Delhi, 2012.
2. Arun Kumar & N Meenakshi, Marketing Management, Vikas Publishing House Pvt Ltd, New Delhi, 2011.
3. Varshney R L and Gupta S L., Marketing Management, Sultan Chand & Sons, New Delhi, 2004.
4. Adrian Palmer., Principles of Marketing, Oxford University Press, New York, 2000.

HUM 4054: OPERATIONS MANAGEMENT [2 1 0 3]

Introductions to operations management – process view and supply chain view, types of production activities, competitive priorities and capabilities. Break-even analysis, evaluating services or products, evaluating processes - make or buy decision, decision making under risk, and decision trees. Introduction to forecasting, importance and uses of forecasting, demand patterns, demand management options, judgement methods, causal methods - linear regression, time series method – naïve method, moving average, weightage moving average, and exponential smoothing curve. Planning long-term capacity, measures of capacity and utilization, economies of scale, diseconomies of scale, capacity timing and sizing strategies, sizing capacity cushions, timing and sizing expansion – expansionist strategy, wait and see strategy, and a systematic approach to long term capacity decision. Levels in operations planning and scheduling across the organization, sales and operation planning strategies- chase strategy, level strategy, operations planning using linear programming technique, scheduling job and facility scheduling, and work for scheduling. Theory of constraints, managing bottle necks in manufacturing and service processes, identifying bottle necks, relieving bottle necks, drum buffer rope system, and managing constraints in a line system. Supply chain design across the organization, supply chains for services and manufacturing, measures of supply chain performance - inventory measures, financial measures, inventory and supply chains - pressures for small inventories, pressures for large inventories, types of inventory, inventory reduction tactics, and inventory placement. Costs of quality, total quality management, acceptance sampling, statistical process control - control charts, and process capability. Continuous improvement using lean systems, different types of wastes, strategic characteristics of a lean system, designing lean system layout, and Kanban system.

References:

1. Krajewski L. J., Ritzman L. P., Malhotra M., and Srivastava S. K., *Operations Management*, 11th edition, Pearson Education (Singapore) Pvt. Ltd., Delhi, 2016.
2. Heizer J. and Render B., *Operations Management*, 11th edition. Pearson Education India, 2016.
3. Khanna R. B., *Production and Operations Management*, 2nd edition, PHI Learning Private Limited, 2015.

OPEN ELECTIVES

HUM 4301: COMMUNICATIVE ENGLISH [3 0 0 3]

(Offered for Lateral Entry Students only)

Common Errors in English: Subject Verb Agreement; Uses of Tenses / Sequence of Tense; Prepositions; Articles; Special Usages; Creative Writing Essay: Types of Essays, Argumentative Essay, Descriptive/ Expository/Narrative Essays; Reading Comprehension; Dynamic text; Critical Evaluation; Group Discussions; Presentation Skills; Essay writing.; Audio texts/speeches -Practice listening skills- summary, commentary, listening exercises. Video Speeches -Theme based speeches - motivational, informative, technical, and persuasive, discussions. Speech - Elements of a good speech, types of speeches, model speech, Speech exercises, individual presentations, peer and facilitator feedback. Formal/Informal communication. Communication Styles- formal and informal, standard English and variations in usages, examples and analysis of faulty usages; Correspondence: formal/informal letters and emails .

References:

1. Green David., *Contemporary English Grammar, Structures and Composition* Chennai: Macmillan Publications.
2. Thompson AJ & Martinet AB., *A Practical English Grammar*, OUP.
3. Turton N D , Heaton J B., *Longman Dictionary of Common Errors*, 1998.
4. Meenakshi Raman & Sangita Sharma., *Technical Communication; Principles and Practice*, Oxford University Press, 2011.

HUM 4302: FILM STUDIES [2 1 0 3]

History of invention of motion pictures - Daguerre, Muybridge, Edison, Skaldanowsky Brothers, Lumieres; Evolution of film – Lumieres, Melies, Porter, Griffith, Basic techniques – Mise-en-scene, Mise-en-shot, Deepfocus Photography, Longtake, Continuity, Editing, Montage, German Expressionism; French Impressionism; Soviet Montage cinema; Hollywood cinema, Italian Neo-realism; French Nouvelle Vague, Documentary, Directors – Eisenstein, Kurosawa, Godard, Chaplin, Bergman; Mohsen Makmalbaf, Majid Majidi, Keislowksi, Zhang Yimou, Kim Ki Duk, “New Wave” Cinema in India - Bengali; Malayalam; Kannada; Hindi, To be screened- Bicycle Thieves, The 400 blows, Rashomon, Wild strawberries, Battleship Potemkin, Cabinet of Dr. Caligari, The kid, Children of heaven, Hero, Ghatashraddha, Pather Panchali, Mathilukal.

References:

1. Bordwell, David and Thompson, Kristin., *Film Art: an Introduction*, 7th ed. New York: McGraw-Hill Co., 2004.
2. Kavin, Bruce., *How Movies Work*. Berkeley and Los Angeles: University of California Press, 1992.
3. Cook, David A., *A History of Narrative Film*, 4th ed. New York: W.W. Norton & Co., 2004.

HUM 4303: GERMAN FOR BEGINNERS [3 0 0 3]

Text selections, dialogue and exercises which have been designed to give the absolute beginner grounding in the rudiments of the German language, as well as providing background information about the history, life and culture in Germany. Introduction to the German alphabet and the German language – dialogues & conversations – pronunciation, basic vocabulary lists - key points of grammar - background information about the history and culture of Germany - exercises on vocabulary, grammar and German culture - reading & listening comprehension.

References:

1. Sally Johnson, Natalie Braber., *Exploring the German Language*, (2E), Cambridge University Press. 2008.
2. Charles Russ., *The German Language Today: A Linguistic Introduction*, Routledge. 1994.

HUM 4304: BUILDING BRIDGES: INDO-EUROPEAN INTERCULTURAL DYNAMICS [3 0 0 3]

The challenges of Intercultural communication - interacting in a diverse world, understanding cultures, alternative views of reality, cultural stereotyping. Foundational Theories in Intercultural Communication - Edward Hall, Samovar, G Hofstede, Understanding cultural Dimensions and Cultural Stereotyping- collectivism/ individualism, power distance, masculine/feminine, cultural metaphors, Intercultural Business Communication Competence - The Role of Language in Intercultural Business Communication , Nonverbal Language in Intercultural Communication, Cultural influence on interpersonal communication, Intercultural Dynamics in the multicultural organizations.

References:

1. Dodd, Carley H. *Dynamics of Intercultural Communication*, McGraw-Hill, Boston. 1998.
2. Gannon M J and Pillai R. *Understanding Global Cultures*, Sage Publications, California. 2010.
3. Hall, E. T. *The dance of life: The other dimension of time*, Random House, New York. 1983.
4. Hofstede, Geert., *Cultures' Consequences, Comparing Values, Behaviors, Institutions, and Organizations across Nations*, Sage Publications, Thousand Oaks, CA. 2001.
5. Martin, J.N. & Nakayama, T.K., *Intercultural communication in contexts*. 4th Edition. Mountain View, CA: Mayfield. 2007.
6. Samovar, L A and Porter, R., *Communication between Cultures*, Cengage Learning, Wadsworth, CA. 2007.

HUM 4305: INTERPRETATION OF LITERARY TEXTS [3 0 0 3]

Texts-static, dynamic, cryptic and delphic ; Language of literature; Form and structure; Literature verses popular fiction; Text and discourse; Authors and critics; Theories and approaches to literary texts; Formalism, Structuralism, Marxism, Feminism, Deconstruction; Ideational functions and textual Functions; Class, gender and sexuality; Race and nationality; Genre, phonological deviations –sound patterns and figures of speech ; Pragmatic approach to literature; Understanding syntax, Lexical and syntactic analysis of literary texts; Point of view in literary texts and foregrounding; Prediction and making sense of a text; Stylistic analysis of a novel; Kinds of meaning, Rhetorical structure; Pragmatics and discourse analysis; Interpreting cohesive devices and complex functional values; Stylistic approach to literature ; Elements of literary style; Stylistic analysis of selected short stories, Poems, Novels and Plays; Genre, the plot setting, characterization, tone and themes; Stylistics and its implications on narrative techniques; Intertextuality and conceptual blending; Identifying patterns in the texts; Meaning making process in literature; Imagery, metaphor as a mode of thought; Coherence and Cohesion; Context, turn taking and Adjacency Pair; Pro-forms, Discourse markers, Lexical cohesion and presupposition; Recognizing text organization; Critical texts, Shared assumptions on critical texts; The role of schema and the concept of speech acts in literary texts.

References:

1. Austin, J.L., *How to do Things with Words*, Longman, London, 1992.
2. Barthes. R., *Introduction to the Structural Analysis of Narratives*, Fontana, London, 1977.
3. Blake.N.F., *An Introduction to the Language of Literature*, Macmillan, London. .1990.
4. Carter, R. (ed.), *Language and Literature: An introductory Reader in Stylistics*, Allen and Unwin, London, 1982.
5. Cook, G., *Discourse and Literature*, Oxford University Press, London, 1994.
6. Harold, C.M.(ed.), *Style in Prose Fiction*, Columbia University Press, New York.
7. Leech, G.N., *A Linguistic Guide to English Poetry*, Longman, London, 1969.

HUM 4306: PUBLIC SPEAKING [3 0 0 3]

Public Speaking -Introduction to Public speaking- Voice modulation, Sounds/accents (basics), Articulation, Anxiety management, Logical arguments, Concept of purpose, Audience, Smart use of Body language. Types of speech-Informative speeches - designing and delivery-Persuasive speeches – designing and delivery- Impromptu speeches – designing and delivery -Special occasion speeches- designing and delivery, Presentations - planning and execution -Types of presentation - Informative-Planning and delivery - Persuasive - Planning and delivery - Motivational - Planning and delivery, Other forms of speaking – Debates, Seminars, Panel Discussion, Group Discussion, Tall Tales, Turn Coat, Art of Evaluation-Providing feedback- planning, designing and delivering constructive feedback - Receiving feedback – making use of relevant feedback -Techniques of providing feedback- Speech analysis –Role of the Evaluator.

References:

1. Duarte Nancy., *Resonate: Present Visual Stories that Transform Audiences*, John Wiley and Sons, 2010.
2. Minto Barbara., *The Pyramid Principle: Logic in writing, thinking and Problem Solving*, Financial Times Prentice Hall, 2002.
3. Berkun Scott., *Confessions of a Public Speaker*, O'Reilly Media, 2009.
4. Goodale Malcolm., *Professional Presentations*, Cambridge University Press, 2005.
5. Carnegie Dale., *The Art of Public Speaking*, 1905.

HUM 4307: INTRODUCTION TO PSYCHOLOGY [3 0 0 3]

Psychology - Meaning, Nature and Scope, Defining Psychology, Meaning of the term Behavior, Nature of Psychology, Scope of Psychology: Branches and fields of Psychology. Development of Psychology - Historic Sketch of Psychology, Modern Age of Psychology, Gestalt Psychology, Psycho Analysis, Contemporary Psychology. Systems of Psychology- The Nervous System, Nature V/s Nurture, Sensation and perception, States of Consciousness. Methods of Psychology - Classical Conditioning, Introspection Method, Naturalistic Method, Experimental Method, Differential Method, Clinical Method, Psycho Physical Method. Personality- Personality types, Personality Disorders, Abnormal psychology, Treatment of personality disorders. Thinking - Nature of Thinking, Types of Thinking, Language and Intelligence. Discussion, Presentation and Assignments.

References:

1. Boring, E.G., Langfield, H.S. & Weld, H.P., *Foundations of Psychology*, Asia Publishing House, Calcutta, 1963.
2. Carson, R.C., Butcher, J.N. & Coleman, J.C., *Abnormal Psychology & Modern Life*, (8th ed) Scoff, Foresman & Co. 1988.
3. Lahey, B.B., *Psychology: An Introduction*, 6th Ed., Tata McGraw Hill, New York, 1965.
4. Olson, M.; Hergenhahn, B.R., *Introduction to the Theories of Learning*, Prentice-Hall India, 2009.

HUM 4308: INTRODUCTION TO PHILOSOPHY, RELIGION AND CULTURE [3 0 0 3]

Notions of Philosophy; The Origin and Development of Philosophy; Ancient Philosophy; Medieval Philosophy; Modern Philosophy; Contemporary Philosophy; Indian Philosophy; Comparative Religion; Western Philosophy; The Relevance of Philosophy; Branches of Philosophy; Methods of Philosophy; Philosophy and other Branches of Study; Some Problems of Philosophy; Themes of Philosophy; Mind and Body, and the Problem of Universal; Change/Movement time and place; Existence of God and Evolution; Indian Culture; Social Ethics; Logic and Scientific Methods; Philosophy of Language.

References:

1. Aquinas, Thomas., *On Being and Essence. Trans. Armand Maurer.* Canada: Pontifical Institute of Mediaeval Studies, 1968.
2. John-Terry, Chris., *For the Love of Wisdom: An Explanation of the meaning and Purpose of Philosophy.* New York: Alba House, 1994.
3. Maritain, Jacques., *An Introduction to Philosophy*, London: Sheed and Ward. 1979.
4. Radhakrishnan, S. (Ed)., *History of Philosophy Eastern and Western Vol. II* George Allen and Unwin Ltd., London, 1953.
5. Wallace, William., *The Elements of Philosophy.* New York: Alba House, 1990.

HUM 4309: CREATIVE WRITING [3 0 0 3]

Various literary/prose forms and their characteristics; techniques and strategies for reading; nuances of language and meaning in reading and writing; Writing Exercises - techniques and strategies of writing creatively; Critical Concepts and Terms in Literary Writing; Writing Exercises; creative writing output.

References:

1. Milan Kundera ., *The Art of the Novel.*
2. The Art of Fiction: Illustrated from Classic and Modern Texts, David Lodge

HUM 4310: GRAPHIC NOVELS: HISTORY, FORM AND CULTURE [3 0 0 3]

Part I: The History of Comic Books, Part 1: Developing a Medium Defining comic books as a medium-Relationships between comic books and other forms of sequential art-The (continental) roots of comics as an art form -The ways in which comic strips and pulps contributed to the emergence of the comic book. The History of Comic Books, Part 2: The Maturation of the Medium-Influence of underground movement, ways in which mainstream publishers began to address more relevant topics, proliferation of independent comics, the increase in the profile and prominence of the medium due to ambitious projects. Part II: Creating the Story: Graphic Storytelling and Visual Narrative-Some narrative structures commonly found in comic books -The types and techniques of encapsulation-The nature of the relationship between the pictorial and linguistic elements of comic books Experiencing the Story: The Power of Comics - About diegetic images that show the world of the story-About interpretive images that comment on the story-The impact art style has on the emotional reactions of the reader; and how the meaning of each image is affected by the relationship to other images in that particular book, in other texts, and in the reader's personal experience-Part III: Comic Book Genres-the definition of genre and the role it plays in shaping the creation of comics products- the characteristics of genres, including character types, narrative patterns, themes, and other conventions-how the example genres of teen humor, romance, funny animals, horror, and memoir developed in comics, and what characterizes each-how the hybridization of genres helps experimentation and expansion of narrative possibilities.

References:

1. Roger Sabin., *Comics, Comix and Graphic Novels.*
2. Robert Petersen, Allan Moore., *Comics, Manga and Graphic Novels: A History of Graphic Narrative*3. *Comics as Performance, Fiction as Scalpel.*
3. Jeet Heer, Kent Worcester., *Arguing Comics: Studies in Popular culture.*

HUM 4311: MANAGEMENT INFORMATION SYSTEMS [3 0 0 3]

Management information system: Introduction to management, information and system. System concepts, general model of a system and types of systems. Evolution of MIS, models and resources used in the MIS model. Structure of MIS, operating elements of an information system, synthesis of the structure. Information systems for different applications: Transaction processing systems, Human resource management systems and Marketing-application areas. Production planning and Office automation systems. Role of management information in decision making: Concepts of decision making, Decision making process and information needs at different levels of management. Herbert. A. Simon model. Phases in the decision making process, Programmed vs non-programmed decisions, General model of human as an information processor, Allen Newell Simon model. Decision support systems -structure, elements and working. Information as a strategic resource. MIS as a technique for making programmed decisions: Behavioral models of the decision maker and methods. MIS support for decision making. Role of MIS in Organizations -recent trends and e-commerce applications. Development of customized management information system approaches: SDLC -phases in SDLC, Strategic and project planning for MIS, conceptual design and detailed design phases: general business planning and MIS response. MIS Planning and planning cycle. Conceptual system design and Detailed System design. MIS System Implementation, and Pit falls: Pit Falls in MIS development, Fundamental weaknesses, soft spots in planning, design problems and review.

References:

1. Gordon B. D. and Margrethe H. O., (2005), "Management Information Systems", McGraw-Hill, New York.
2. Kenneth L. and Price J. P., (2003), "Management Information Systems", Macmillan.
3. Jawadekar W. S., (2000) "Management Information System", Tata McGraw Hill.
4. Senn J. A., (2003), "Analysis & Design of Information System", McGraw Hill International Student Edition.
5. Mudrick; Ross (1997) "Information Systems for Modern Management" Prentice Hall of India.
6. James A. O'Brien (1995) "Management Information Systems, Galgotia Publications.

HUM 4312: ENTREPRENEURSHIP [3 0 0 3]

Entrepreneur: Meaning of entrepreneur, evolution of the concept, functions of an entrepreneur, types of entrepreneur, and intrapreneur. Concept of entrepreneurship - evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India, barriers for entrepreneurship. Small scale industry: Definition, characteristics, need and rationale. Objectives, scope, role of Small Scale Industries (SSI) in economic development, advantages of SSI, steps to start an SSI - government policy towards SSI, different policies of SSI, impact of liberalization, privatization, and Globalization. Effect of WTO/GATT and supporting agencies of government for SSI. Institutional support: Different Schemes: TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency: SISI, NSIC, SIDBI, and KSFC, New schemes and support for start-ups and new venture under Govt. of India. Preparation of Business plan and project report: components of a successful plan. Meaning of project, project identification, project selection, project report, need and significance of report, contents, formulation, guidelines by planning commission for project report. Network analysis, errors in project report, project appraisal. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study and documentation and evaluation.

References:

1. Vasant Desai., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House, 2007.
2. David H. Holt Entrepreneurship: New Venture Creation, Published by prentice Hall, 1991.
3. Poornima. M. Charantimath., Entrepreneurship Development, Pearson Education, 2006.
4. S.S. Khanka., Entrepreneurship Development, S.Chand& Co, 2007.



Minor Specialization: Material Science

PHY 4051: PHYSICS OF LOW DIMENSIONAL MATERIALS [3 0 0 3]

Thin films: Thick and Thin Film Materials, preparation by physical and chemical methods. Thickness measurement techniques. Theories of nucleation - Capillarity and atomistic theory, effect of deposition parameters on nucleation and growth of thin films. Epitaxial growth. Reflection and Transmission at interface between isotropic transparent media. Reflectance and Transmittance in thin films. Antireflection coatings. Electrical conduction in discontinuous metal films - Quantum mechanical tunneling model. Conduction in continuous metal and semiconducting films. Thermoelectric power in metal films. thin film resistors, thermopiles. Quantum well devices.

Nanomaterials: Chemical Synthesis of Nanoparticles: Bottom up approach. Functionalized nanoparticles in different medium. Size control. Self assembly. Nanoparticle arrays. Semiconductor nanoparticles- synthesis, characterization and applications of quantum dots. Magnetic nanoparticles- assembly and nanostructures. Manipulation of nanoscale biological assemblies. Carbon nanotubes and fullerene as nanoclusters. Nanostructured films. Physical Methods of Nanostructure Fabrication: Top down approach. Nanopatterning- Lithography- Optical, X-ray and Electron beam lithography. Ion- beam lithography.

References:

1. Chopra K. L., *Thin Film Phenomena*, Mc Graw Hill, 1969
2. Milton Ohring, *Materials Science of Thin Films*, Elsevier, 2001
3. Heavens O. S., *Optical Properties of Thin Solid Films*, Dover, 1955
4. Liz-Marzan L. M. and Kamat P. V. (Eds), *Nanoscale Materials*, Kluwer, 2003
5. Nalwa H. S. (Ed), *Nanostructured Materials and Nanotechnology*, Academic, 2002

PHY 4052: PHYSICS OF PHOTONIC AND ENERGY STORAGE DEVICES [3 0 0 3]

Semiconductors: Direct and indirect band gaps. Carrier concentrations at thermal equilibrium. Fermi level. Degenerate and non-degenerate semiconductors. Semiconductor Crystal growth techniques Contact phenomenon- semiconductor-semiconductor, metal-semiconductor contacts. Schottky and Ohmic contacts. Preparation of semiconductor devices. IC technology, elements of lithography.

Photonic Devices: LED and semiconductor lasers: Radiative and non-radiative transitions, diode laser, population inversion, laser operating characteristics, efficiency, photoconductor, photodiode, avalanche photodiode, phototransistor, material requirement for solar cells, theory and types of solar cells.

Fuel cells: Hydrogen energy – merits as a fuel – production of hydrogen, Hydrogen Fuel cells – introduction – difference between batteries and fuel cells, components of fuel cells, principle of working of fuel cell, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages of fuel cell power plant. Types of fuel cells. Application of fuel cells – commercially available fuel cells.

References:

1. Neamen Donald A., *Semiconductor Physics and Devices, basic principles*, Tata McGraw-Hill, 2002
2. Sze S. M., *Physics of Semiconductor Devices*, John Wiley & Sons, 2007
3. Larminie J. and Dicks A., *Fuel Cell Systems Explained*, Wiley, 2003
4. Xianguo Li, *Principles of Fuel Cells*, Taylor and Francis, 2005
5. S. Srinivasan, *Fuel Cells: From Fundamentals to Applications*, Springer, 2006

OPEN ELECTIVES

PHY 4301: FUNDAMENTALS OF ASTRONOMY AND ASTROPHYSICS [3 0 0 3]

Introduction to astronomy and astrophysics. Properties of ordinary stars: Brightness of starlight; the electromagnetic spectrum; Colours of stars; stellar distances; absolute magnitudes; HR diagram. Stellar evolution: Formation of star; the main sequence; stellar structure; evolution off the main sequence; planetary nebulae; white dwarfs. The death of high mass stars: Supernovae; neutron stars; pulsars; stellar black holes. Normal Galaxies: Types of galaxies; Dark matter in galaxies. Cosmology: The scale of universe; expansion of the universe; open or closed universe; the big bang; the cosmic background radiation; big bang nucleosynthesis. Astronomical instruments.

References:

1. Marc L Kutner, *Astronomy: A physical Perspective (2e)* Cambridge University Press, 2003
2. Baidyanath Basu, *An Introduction to Astrophysics (2e)*, PHI Learning Pvt. Ltd, 2011.
3. Michael Zeilik, *Introductory Astronomy and Astrophysics (4e)*, Saunders College Pub. 1992.

PHY 4302: PHYSICS OF ENGINEERING MATERIALS [3 0 0 3]

Types of magnetism, ferromagnetic domains, soft and hard magnetic materials, ferrites, magnetic storage, Superconducting materials, Applications of superconductors, Nano-materials, bottom-up and top-down methods, Quantum dots and nano-carbon tubes, Composite materials, micromechanics of composites - Density, Mechanical and Thermal properties, Semiconductors, Metals, semiconductors and insulators, Direct and indirect band-gap semiconductors, Intrinsic and extrinsic semiconductors, Diffusion and drift processes, Crystal growth techniques, Preparation of semiconductor devices.

References:

1. William F. Smith, *Principles of Materials Science and Engineering (2e)*, McGraw-Hill International Edition, 1990.
2. Nalwa H.S., *Nanostructured Materials and Nanotechnology (2e)*, Academic, 2002.
3. Chawla K. K. *Composite Materials- Science & Engineering (3e)*, Springer-Verlag, 2012.
4. Streetman Ben G. and Banerjee Sanjay Kumar, *Solid State Electronic Devices (6e)* PHI learning Private Limited, 2012.

PHY 4303: RADIATION PHYSICS [3 0 0 3]

Radiation Sources: Fast electron sources-Heavy charged particle sources-Sources of electromagnetic radiation-Neutron sources. Radiation Interaction: Photoelectric and Compton process -pair production. Interaction of heavy charged particles-stopping power-Energy loss characteristics- Bragg curve-Particle range-range straggling- stopping time-energy loss in thin absorbers-Interaction of fast electrons-absorption of beta particles-interaction of gamma rays-gamma ray attenuation-Interaction of neutrons-neutron cross section-neutron induced nuclear reactions. Radiation Detectors and Instrumentation: Semiconductors diodes-JFET-MOSFET-Integrated Circuits-OPAMP and their characteristics-Differential Amplifier-Operational amplifier systems-Pulse Amplifiers. Principles of radiation detection and measurements-Gas filled detectors-Ionisation chambers-Proportional counters-GM counters-Scintillation detectors-Semiconductor detectors-Thermo luminescent Dosimeters-Radiation spectroscopy with scintillators-Gamma spectroscopy-Multichannel pulse analyzer-Slow neutron detection methods-Reactor instrumentation. Industrial uses of nuclear measurements: Radiation detection in industrial environments-Measuring systems for industrial problems-Determination of physical material characteristics by nuclear measurements-Level height determination-Density measurements-Quantity measurements-Thickness measurement-coating thickness measurement.

References:

1. Knoll G. F., *Radiation Detection and Measurement (3e)*, Wiley 2010
2. Boylestad R. L., *Electronic Devices and Circuit theory (11e)*, Pearson Education 2016
3. Malvino A. P., *Electronic Principles (7e)*, TMH 2010
4. Foldiak G., *Industrial Applications of Radioisotopes*, Elsevier Science Ltd 1986

PHY 4304: SOLID STATE PHYSICS [3 0 0 3]

Review of Crystal structure: Lattice, basis and unit cell, crystal system, symmetry, crystal planes and miller indices, reciprocal lattice, Bragg's law, experimental methods of x-ray diffraction, types of crystal binding, analysis of stress and strain in crystals. Electrical conduction: Free electron gas model, Sommerfeld quantum theory, Fermi energy, parameters of free electron gas at absolute zero, electrical conductivity, Drude-Lorentz theory and Sommerfeld theory of electrical conductivity, Band theory of solids, electrical conduction in metals, insulators and semiconductors. Dielectrics: Static dielectric constant, polarization and polarizability, local field, ferroelectricity, piezoelectricity, frequency dependence of polarizability (electronic, ionic and dipolar), dielectric losses, requirements of insulating materials, applications of dielectric materials. Magnetism: Classification of magnetic materials, classical theory of diamagnetism and paramagnetism, Weiss theory of ferromagnetism, ferrites, hard and soft magnetic materials, garnets, magnetic bubbles, ceramic magnets, applications of magnetic materials

References:

1. Kittel C., *Introduction to Solid State Physics (7e)*, Wiley 1996.
2. Rao A., *A first course Solid State Physics*, Asiatech publications 2000.
3. Pillai S.O., *Solid State Physics (6e)*, New age international publications 2006.
4. Wahab M. A., *Numerical problems in Solid State Physics*, Alpha science international publications 2011.
5. Gupta H. C., *Solid State Physics*, Vikas publishing house Pvt. Ltd. 1996.

PHY 4305: MODERN OPTICS [3 0 0 3]

Optics: Review of geometrical and physical optics, Dual nature of light, Electromagnetic spectrum, Optical devices, mirrors, lenses, prisms, grating, beam splitters, zone plate, polaroids. Light sources, emission profile. Elements of lasers: Basic requirements in a laser, characteristic properties of lasers. Q-switched and mode locked lasers. CO₂, Nd: YAG lasers. Applications. Introduction to Non-linear optics. Optoelectronic devices and its application: Photo diodes, solar cells, LED, and diode lasers. DBR and DFB lasers, CCD. Optical Communication: Conceptual picture of the optical communication system, Modulation and Detection

Schemes, properties of optical fibers, discussion on device requirements, OEICS. Optical storage devices: Data recording and read out from optical discs. Holographic data storage systems.

References:

1. Ghatak A., *OPTICS (4e)*, Tata McGraw Hill Publishing Company Ltd. 2009.
2. Singh J., *Optoelectronics: An Introduction to Materials and Devices*, TATA McGraw- Hill Companies, Inc. 2014.
3. Wilson & Hawkes, *LASERS*, Prentice-Hall of India Pvt. Ltd. 1987.
4. Hugh Bennett, *Understanding Recordable & Rewritable DVD*, OSTA.org.
5. Hugh Bennett, *Understanding CD-R & CD-RW*, OSTA.org.

PHY 4306: INTRODUCTORY QUANTUM MECHANICS [3 0 0 3]

Review of certain basics: Limitations of classical physics, wave-particle duality, De Broglie's hypothesis, matter as wavepacket, Heisenberg's uncertainty principle, Mathematical Formalism: operators; commutation relation; orthonormal functions; eigenvalues and eigenfunctions; the Dirac notation; the postulates of quantum mechanics. The Schrödinger Equation: Introduction, wavefunctions, time dependent Schrödinger equation, conservation of probability, expectation values, Ehrenfest's theorem, time independent Schrödinger equation, stationary states, Schrödinger equation in one dimension: the infinite square potential well; the finite square potential well; the potential barrier; tunneling; the harmonic oscillator. Quantum mechanics in three dimensions: Schrödinger equation in spherical coordinates, separation of variables, the angular equation, the radial equation, Applications (energy eigenvalues and eigenfunctions): the rigid rotator; the hydrogen atom; angular momentum. Identical Particles. Some applications of quantum mechanics in nuclear physics, condensed matter physics, and spectroscopy: alpha decay, nanostructures, STM, vibrational and rotational spectra of molecules etc.

References:

1. Verma H.C., *Quantum Physics (2e)*, Surya Publications. 2016.
2. Gasiorowicz S., *Quantum Physics (3e)*, Wiley India Pvt Limited. 2007.
3. Jain M. C., *Quantum Mechanics: A Textbook for Undergraduates*, PHI Learning Private Limited 2012.
4. Griffiths D. J., *Introduction to Quantum Mechanics (2e)*, Pearson Education.
5. Eisberg R. and Resnick R., *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2e)*, Wiley-India Pvt Limited. 2009.

Minor Specialization: Material Science

CHM 4051: CHEMICAL BONDING [3 0 0 3]

Introduction to bonding, Classification. Ionic bond- Lattice energy, Born Haber cycle, Radius-ratio rules, Properties of ionic compounds, Covalent character in ionic bonds. Covalent bond-Covalency, Valence bond theory, Sigma and pi bond, Hybridization, VSEPR Theory, Molecular orbital theory, Bond order, Properties of covalent compounds. Coordination bond - Primary and Secondary valencies, ligands, Valence bond theory of complexes, Crystal field theory of octahedral and tetrahedral complexes, Low and high spin complexes. Metallic bond-Band theory of metals, Conductors, semiconductors and insulators. Secondary bonding- Hydrogen bonding, London forces and dipole-dipole interactions.

References:

1. J D Lee, "Concise Inorganic chemistry", Wiley India, 2012
2. B R Puri , L R sharma and K C Kalia, "Principle of Inorganic chemistry", Vishal Publishing Co., Punjab, 2017.
3. D F Shriver, P W Atkins, "Inorganic chemistry", Oxford India, 2014
4. A F Cotton, "Basic Inorganic chemistry", Wiley Publishers, 2007

CHM 4052: CHEMISTRY OF CARBON COMPOUNDS [3 0 0 3]

Introduction to Organic Compounds: Classification, Nomenclature; Alkanes: Homologous series, Preparation; Cycloalkanes: Ring size and strain, Applications; Alkenes: Markovnikov and anti-Markovnikov addition reactions, Reduction, applications; Alkynes: Acidity, preparation, Reduction of alkynes, applications; Alkyl halides: SN1, SN2, E1 and E2 reaction mechanisms; Alcohols: Classification, Acidity, organo-metallic reagents; Aromatic compounds: Electrophilic and nucleophilic substitution reactions; Mechanism of some named reactions; Carbonyl compounds: aldehydes and ketones, carboxylic acids and carboxylic acid derivatives; Heterocyclic compounds: Nomenclature, synthesis and reactivity of thiophene, pyrrole and furan; Carbon materials: Fullerenes, carbon thin films, nanotubes and carbon fibers; Carbon nanotubes: SWNT, MWNT, synthesis, properties and applications; Carbon nanomaterials applications.

References:

1. B S Bahl and Arun Bahl, "Advanced Organic Chemistry", S Chand, New Delhi, 2012.
2. Robert T. Morrison and Robert N. Boyd, "Organic Chemistry", Pearson, New Delhi, 2016.
3. P.S. Kalsi, "Organic Reactions and Their Mechanisms", New Age International Private Limited, New Delhi, 2017.
4. Ashutosh Tiwari and S. K. Shukla, "Advanced Carbon Materials and Technology", John Wiley & Sons, 2013.
- B. Bhushan ed., "Springer Handbook of Nanotechnology", Springer Publishers, Berlin, 2004.

OPEN ELECTIVES

CHM 4301: ANALYTICAL METHODS AND INSTRUMENTATION [3 0 0 3]

Spectroscopic methods of analysis: Properties of EMR, General features of spectroscopy, Types of molecular spectra, Interaction of EMR with matter, Instrumentation, Applications, Theory, Instrumentation and applications of Microwave, Raman, Infrared, UV-Visible, NMR spectroscopic techniques. Chromatographic Techniques: General

concepts, Classification, Principles, Experimental techniques of CC, HPLC, TLC, GC and their applications. Electroanalytical methods: Basic principles and applications of conductometric, potentiometric titrations.

References:

1. D.A. Skoog, J. Holler, F.T.A. Nieman, *Principles of Instrumental Analysis*, 5thEdn, Saunders, Philadelphia, 1992
2. D. A. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, 5thEdn, Saunders College Publishing, Philadelphia, 1988
3. *Vogel's Textbook of Quantitative Chemical Analysis*, GH Jeffery, John Wiley & Sons Inc, 5thEdn, 1989

CHM 4302: FUNDAMENTALS OF INDUSTRIAL CATALYTIC PROCESSES [3 0 0 3]

Adsorption & Catalysis: Physisorption and chemisorption, Adsorption isotherms, Factors influencing adsorption, Adsorption of gases by solids, Adsorption from solution, Introduction to catalysis, Energetics, Catalytic cycles Solutions & Solubility: Ideal and non-ideal solutions, Raoult's law, Thermodynamics of ideal solutions, Vapor pressure and boiling point composition curves, Distillation behaviour of completely miscible & immiscible liquid systems, Azeotropes Colligative Properties: Determination of molar masses from vapor pressure lowering, Osmotic pressure, Boiling point elevation and Depression of freezing point, Vant Hoff's factor Colloids: Types, Preparation and purification of sols, General properties, Optical, Electrical & Kinetic properties of sols, stability of sols, Application of colloids, Emulsions & Gels- Types, Preparation, Properties and their applications.

References:

1. *Principles of Physical Chemistry*, B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publications, New Delhi, (23e), 2008
2. *Principles of Physical Chemistry*, S.H. Maron, C.F. Prutton, IBH Publishing co. New Delhi, (4e), 1985
3. *Fundamentals of Analytical Chemistry*, D.A. Skoog, D.M. West, F.J. Holler, R. Crouch, (4e), Thomson-Brooks, 2007

CHM 4303: SUSTAINABLE CHEMICAL PROCESSES AND PRODUCTS [3 0 0 3]

Introduction and principles of green chemistry, Examples, Atom economy, carbon efficiency, life cycle analysis, sustainable products, process and synthesis catalysis and green chemistry, examples of fine and bulk chemicals production, catalysts for clean technology. Application of ecofriendly approach to waste treatment. Cleaner production processes, clean synthesis in lab Scale, industrial examples, use of ecofriendly energies. Bio-pesticides, polymers & pharmaceutical products. Electrochemical synthesis, Alternate reaction media using water and other green solvents, ionic liquids & supercritical fluids; phase transfer catalysis.

References:

1. P.T. Anastas, J. C. Warner, *Green Chemistry: Theory and Practice*, Oxford Univ. Press, Oxford, 2008
2. A.S. Matlack, *Introduction to Green Chemistry*, Marcel Dekker, New York, 2001
3. P. T. Anastas, R. H. Crabtree, *Handbook of Green Chemistry and Catalysis*, Wiley-VCH, Weinheim, 2009

Inter Institute Open Electives

Centre for Creative and Cultural Studies (CCCS), Manipal

IIE 4301: ART APPRECIATION [3 0 0 3]

How to read a visual, how to enjoy or feel an art form, what is Creative Thinking? Indian Art: Heritage & Culture; Art Appreciation: Western Art, Artist & Art Movements: Raja Ravi Verma, Tagore, Da Vinci, Van Gogh; Aesthetics: Beauty, Feel & Expression; Art & Science; Art & Film; Art: Freedom & Society, to be an art literate. A journey to immerse in the world of Art.

IIE 4302: INDIAN CULTURE AND CINEMA - AN INTRODUCTION [3 0 0 3]

Introduction to Idea of Culture, Identity and tradition, Indian Cultural History, Indian cultural history, Time and space, Indian Art and heritage, Indus valley civilization – Indian Independence, Post-colonial India, Modern India, Indian Cinema, Body, language and feel, Film and culture, Evolution, Interpretation and Reflection, Indian Cinema, Media and the medium, Pioneers and classical films, Culture and art of cinema, Culture, Cinema and Society, Revolutions, ideas, innovations, Culture, Cinema and Peace, Message, purpose and the challenge.

Manipal Institute of Management, Manipal

IIE 4304: CORPORATE FINANCE [3 0 0 3]

Introduction to Corporate Finance, Financial Goal, Agency Problems, Managers vs Shareholders Goals, Concepts of Value and Return, Capital Budgeting Decisions, Cost of Capital, Calculation of the Cost of Capital in Practice, Financial and Operating Leverage, Capital Structure, Relevance of Capital Structure, Irrelevance of Capital Structure, Relevance of Capital Structure, Dividend Theory, Dividend Relevance, Dividend Relevance, Dividend and Uncertainty, Dividend Irrelevance, Principles of Working Capital Management.

References:

1. Brealey, R., Myers, S., Allen, F., & Mohanty, P. (2014). Principles of Corporate Finance (11e). New Delhi: Mc Graw Hill Education (India) Private Limited.
2. Pandey, I. M. (2014). Financial Management (10e). New Delhi: Vikas publishers.
3. Ross, S. A., Westerfield, R. W., Jaffe, J., & Kakani, R. K. (2014). Corporate Finance (10e). New Delhi: Mc Graw Hill Education (India) Private Limited.
4. Parasuraman, N. R. (2014). Financial Management - A Step-by-Step Approach (1e.). New Delhi: Cengage Learning India Private Limited.

IIE 4305: INTERNATIONAL BUSINESS MANAGEMENT [3 0 0 3]

Historical perspective of international business, International business environment, Modes of entering international business, Cross-Culture and dynamic market understanding, Differences in Culture, Theories of international business, World Bank, World trade organization, Multinational Corporations and their involvement in International Business, Tariffs and quotas, Balance of Payment Account.

References:

1. Hill Charles, W. L., & Jain Arun, K. (2011). International Business: Competing in the Global Marketplace. (8e), Tata McGraw Hill.
2. Kumar, S. P., & Sanchari, S. (2012). International Business Management-AGlobal Perspective. New Delhi: Excel Books.

IIE 4306: BRAND MANAGEMENT [3 0 0 3]

Introduction to brand management, Developing a brand strategy, Brand resonance and brand value chain, Designing and implementing brand marketing programs to build brand equity, Measuring and interpreting brand performance, Designing and implementing brand architecture strategies, Managing brands.

References:

1. Keller, K. L., Parameswaran, M. G., Jacob, I. (2015). Strategic Brand Management (4e). Noida, India: Pearson Prentice Hall Publication.
2. Rowles, D., (2014). Digital Branding (1e.). UK: Kogan Page Limited.
3. Kapferer, J. N., (2012). The New Strategic Brand Management: Advanced Insights and Strategic Thinking (5e). UK: Kogan Page Limited

Centre for Integrative Medicine & Research (CIMR)

IIE 4307: YOGA [3 0 0 3]

Aim, Objectives, Meanings and Definitions of Yoga, History of Yoga, Concepts and misconceptions of Yoga, Schools of Yoga, Ashtanga Yoga

Subjects by Industry Experts

IIE 4308: HEALTH ECONOMICS [3 0 0 3]

Economics: Understanding Economics, Efficiency, Rational decision making, Opportunity costs, Supply and demand, Price discovery, Health economics: Defining health, Human capital, what does supply and demand mean in the context of health? Arrow on the uncertainty and welfare economics, The Moral hazard, DALY and QALY, Efficiency: The Production possibility frontiers. The production function for health care. Health policy, Defining equity, Standards of healthcare provision Epidemiology, The Healthcare sector, The demand for health, Disease prevalence, The pharmaceuticals market, Cross country case studies.

References:

1. Sloan, Frank A., and Chee-Ruey Hsieh. Health economics. MIT Press, 2012
2. Annemans, L. Health economics for non-economists. An introduction to the concepts, methods and pitfalls of health economic evaluations. Academia Press, 2008
3. Jeffery, Roger. The politics of health in India. University of California Press, 1988.

IIE 4309: DIGITAL MEDICINE [3 0 0 3]

Present day practice of medicine. Limitations of scalability in the present framework. Introduction to computing, algorithms, big data, semantic web, mobility. Communication-WAN/LAN, 3G/4G and 5G. Patient/Electronic Health records. Experience with these records elsewhere Wearables, the physics of data capture. Practical demonstration of wearables Genomics, an introduction. Computational genomics including the software. Imaging –an introduction-ionizing and non-ionizing. Imaging software and science of diagnosis. How all the four 4 pillars-PHR/EHR, Wearables, Genomics and Imaging come together with software as the glue to change the world of medicine.

References:

1. David Mount. Bioinformatics: Sequence and Genome Analysis. CSHL, 2001
2. Durbin, Richard, Sean Eddy, Anders Krogh, and Graeme. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1999

Manipal College of Nursing Manipal

IIE 4310: MEDICAL EMERGENCY AND FIRST AID [3 0 0 3]

Principles of First Aid, First aid kit and equipment, emergency drugs, scene assessment, safety and identifying hazards, patient assessment, Basic Life Support and AED, triage, extrication/stretchers, ambulance. Describe the causes, signs and symptoms and management of respiratory emergencies, acute gastro-intestinal emergencies, musculoskeletal emergencies, dental, ENT and eye emergencies, renal emergencies, nervous system emergencies, hematological emergencies, endocrine emergencies, toxicological emergencies, environmental emergencies, pediatric emergencies, psychiatric emergencies, obstetrical emergencies

References:

1. Pollak, A.N. (2005). Emergency care and transportation of the sick and injured. Massachusetts: Jones and Bartlett publishers.
2. Keen, J. H. (1996). Mosby's Critical Care and Emergency Drug Reference. Missouri: Mosby's year book.
3. Walsh, M. (1990). Accident and emergency nursing. A new approach. Oxford: Butterworth Heinemann Ltd.
4. Sbaih, L. (1992). Accident and emergency Nursing. A nursing model. London: Chapman and Hall.
5. Sbaih, L. (1994). Issues in accident and emergency Nursing. London: Chapman and Hall.
6. Bourg, P., & Rosen, S. P. (1986). Standardized nursing care plans for emergency departments. Missouri: The C. V. Mosby Company.
7. Howard, P.K., & Steinmann, R. A. (2010). Sheehy's Emergency Nursing principles and practice. Missouri: Mosby Elsevier.
8. Sira, S. (2017). First Aid Manual for Nurses (First ed.), New Delhi: CBS Publishers & Distributors Pvt. Ltd.

IIE 4311: LIFE STYLE MODIFICATION AND COMPLEMENTARY AND ALTERNATIVE THERAPIES [3 0 0 3]

Principles and concepts of life style modification and various complementary and alternative therapies, Demonstrate skill in performing different yoga asanas, guided imagery/Progressive muscle relaxation, meditation & Pranayama, reflexology, massage therapy, aerobics, laughter therapy

References:

1. Bhat Krishna K. The power of yoga. Suyoga publications; DK, 2006
2. M.M.Gore. Anatomy & Physiology of yogic practices; (5e), New age book.
3. K N Udupa. Stress and its management by yoga. (2e). Motilal Banarsidas publishers Pvt. Ltd, Delhi, 2007.
4. Yoga and total health. A monthly journal on the yoga a way of life.
5. Swami Satyananda Saraswati. Dynamics of yoga. (2e), Bihar school of yoga, Bihar 1997.

Welcomegroup Graduate School of Hotel Administration, Manipal

IIE 4312: INDIAN CUISINE AND CULTURE PRACTICAL [3 0 0 3]

Introduction to Indian cuisine, Basic Indian gravies, Rice cooking, Preparation of various rice products, Tandoor Cooking, Indian sweets, Comfort Food, Regional and sub-regional cuisine.

IIE 4313: FOUNDATION COURSE IN BAKING AND PATISSERIE PRACTICAL [3 0 0 3]

Introduction to Patisserie and Baking Principles, Special emphasis placed on the study of ingredient functions, Students will have the opportunity to apply basic baking techniques, Understanding fundamentals of yeast dough production, Emphasis on the application of ingredient functions, product identification and recipe interpretation occurs

throughout the course, Pastry Basics and Pie dough, The fundamental production of classical European pastry based desserts are included, Techniques of Cake Making, Techniques of Cookie making, The course emphasizes the preparation and makeup techniques of various cookies.

References:

1. Wayne Gisslen – Professional Baking, (5e), John Wiley USA.
2. Haneman L.J. Bakery: Flour Confectionery HEINMAN.
3. Mermaid Books The Book Of Ingredients DOWELL PHILIP.
4. John Wiley Understanding Baking AMENDOLA JOSEPH.
5. New Age International, A Professional Text to Bakery and Confectionery, KINGSLEE JOHN.
6. Virtue And Company Ltd., The New International Confectioner: WILFRED J. FRANCE.
7. Charrette Jacques, Great Cakes and Pastries, TEUBNER CHRISTIAN.
8. Joseph Amendola, Baker's Manual, (5e), NICOLE REES.
9. Joseph Amendola, Understanding Baking, (3e), NICOLE REES.
10. Culinary Institute Of America, Baking and Pastry: Mastering the Art and Craft, JOHN WILEY.

IIE 4314: GLOBAL CUISINE & CULTURE- PRACTICAL [3 0 0 3]

European Cuisine: Familiarization of ingredients, recipes and preparation of different countries. North American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. South American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Asian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Australian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. African Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Molecular Gastronomy: Additives, Tools, and Recipes. Processed Food: Comparison and Critiquing. Mediterranean and European cuisine: Familiarization of ingredients, recipes and preparation of different countries.

References:

1. The Professional Chef - The Culinary Institute of America
2. Practical Cookery - Kinton, Ceserani and Foscett
3. Food Production Operation - Parvinder S. Bali
4. Professional Cooking - Wayne Gisslen
5. Cookery for the Hospitality Industry - Dodgshun Peters
6. Modern Cookery - Thangam E Phillips

School of Communication, Manipal

IIE 4315: REPORTING AND WRITING [3 0 0 3]

Introduction to news writing news in different media, news, definition of news, news values; types of news other theoretical issues relating to news writing. News Reporting Basic of news writing: structure of news reports; writing the lead; the changes in the composition of the lead; techniques of news gathering; sources of news. Reporting various types of reporting (Objective, Interpretative, Investigative.) General assignment reporting/working on a beat. Reporting for news agency, periodicals and magazines. Interviewing: doing the research, conducting the interview, types and formats of interviews, writing interviews

References:

1. Mencher, Melvin (2006): News Reporting and Writing, Mac-Graw Hill, Boston.
2. Scalnan, Christopher (2000): Reporting and Writing: Basics for the 21st Century, Harcourt College Publishers.
3. Harrington Walt (1997) Intimate Journalism: The Art and Craft of Reporting Everyday Life, Sage Publications.
4. Carole, Rich (2007), Writing and Reporting News: A Coaching Method, Thomson Learning Inc. Kamath, K.V. (1993): Journalists' Handbook, Vikas Publishing House.
5. Aggarwal, Vir Bala (2006): Essentials of Practical Journalism, Concept Publishing Company.

IIE 4316: INTRODUCTION TO ADVERTISING & PUBLIC RELATIONS [3 0 0 3]

Introduction to advertising; Evolution and history of advertising; Influence of advertising on society and ethics. Advertising as part of marketing mix; Structure and types of ad agencies; Advertising planning; creative strategy and implementation (media strategy). The essentials of advertising on different media platforms – print, broadcast, internet and new media; discuss the difference in planning and execution using examples or campaign case studies. Public Relations-scope; definition; evolution; establish difference between PR and advertising; Identifying stakeholders and various Public Relation tools. Steps in developing a PR program/campaign-stating the problem, planning and programming, action and evaluation; Crisis communication; Ethical issues in Public Relations.

References:

1. Butterick, K (2012): Introducing Public Relations: Theory and Practice. New Delhi: SAGE Publications India Pvt. Ltd.
2. Cutlip, Center & Broom, (2000): Effective Public Relations.USA: Prentice Hall International.
3. Jaishri Jethwaney and Shruti Jain, (2012): Advertising Management. New Delhi: Oxford University Press
4. Reddi, C.V.N. (2009): Effective Public Relations and Media Strategy. New Delhi: PHI Learning Pvt. Ltd.
5. Sharma, S. & Singh, R. (2009): Advertising Planning and Implementation. New Delhi: PHI Learning Pvt. Ltd.

IIE 4317: BASIC PHOTOGRAPHY [3 0 0 3]

Photo Journalism: History of Photography and Photo Journalism. Photo Journalism: Definition, Nature, Scope and Functions of Photo Journalism – Qualification and Responsibilities of Photo Journalists, News Photographers and News Value, Types and Sources. Selection, Criteria for News Photographs – Channels of News Pictures – viz., Wire, Satellite, Agency, Stock, Picture Library, Freelancer, Photo Editing, Caption Writing, Photo – Presentation. Legal and Ethical aspects of Photography – Professional Organizations – Camera – Components and Types of Camera – Types of Lens, Types of Films, Types of Filters – Importance of Light and Lighting Equipments – Camera Accessories – Picture appreciation. Digital Camera – Digital Technology and its future – Darkroom Infrastructure – Film developing and Printing

References:

1. Basic Photography – Newnes
2. The Hamlyn Basic Guide to Photography – Hamlyn
3. Hamlyn Encyclopedia of Photography – Hamlyn
4. Photographing People – Guglielmezei
5. History of Photography – Cyernshem G R
6. Photo Journalism – Rothsteline
7. Techniques of Photo Journalism – Milten Feinberg
8. Freelance Photography – Jechsend Gedsey
9. Picture Editing – Stanley E Kalish and Clifton C Edom
10. News Photography – Jack Price
11. 1000 Ideas for better News Picture – High Sidley and Rodney Fox

IIE 4318: MEDIA PRODUCTION TECHNIQUES [3 0 0 3]

Print design elements – typography, colours, spacing, pictures, logos, graphics, principles of layout and design – basic writing skills. Photography – SLR camera, Lenses, Apertures and Shutter speeds, Exposure, Understanding light, Filters and accessories, composing a picture, developing and printing, creating special effects. Digital photography – digital camera – digital technology and its future. Television – Introduction to AV Media-pre-production, production, post-production. Show packaging-Camera-characteristics, parts and

functions; Mounting accessories and movements. Shots-Types and Uses; Basic composition. Practical video recording process. Radio – Introduction to Radio-Microphone types, characteristics and uses; Cables and Connectors. Recording device-Types and Characters, Audio editing, Programme formats-news, drama, feature and PSA's and Advertising.

References:

1. Gerald Millerson, "Effective TV production"
2. Peter Jarvis, "The Essential TV director's Handbook"
3. Hamlyn "Basic guide to photography"
4. Ralph Milton "Radio programming – a basic training manual"
5. Tomlinson Holman "Sound for film and television"
6. Reporting and writing by Melwin Mencher

IIE 4319: GRAPHIC & SKETCHING [3 0 0 3]

Basic Art Principles: Element of Art & Design, Contour Drawing, Composition Principles, Pencil shading, creating geometry model and shading. Basic Perspective: Still life sketching & Drawing, Styles of shading, Introduction to colors, color still life painting, Layout Design, Creating concepts for Design. Skeleton System, Body Proportions, Upper Body, Lower Body, Back, Hands and Legs. Text: Human Anatomy by Victor Perard, Dynamic Anatomy by Burne Hogarth. Gesture Drawing Tips, Line of Action, Dynamic Poses, Body Weight and Gravity, Clothing. Text: Figure Drawing by Anthony Ryder.

List of Practical's:

- ▶ 10 Drawings of Human Anatomy Study In Pencil
- ▶ 50 Drawings of Gesture Drawing In Pencil
- ▶ 5 Contour Drawing
- ▶ 2 Still Life Pencil Shading
- ▶ 2 Color Still Life
- ▶ 2 Layout Design

References:

1. Mastering Composition: Techniques and Principles to Dramatically Improve Your Painting (Mastering (North Light Books)) Hardcover – 25 Jan 2008 by Ian Roberts
 2. Layout Essentials: 100 Design Principles for Using Grids (Design Essentials) Paperback – 1 by Beth Tondreau
 3. Pencil Drawing: Learn how to develop drawings from start to finish with techniques for shading, contrast, texture, and detail (Artist's Library) Paperback – 1 Jan 1988 by Gene Franks
 4. Drawing the Head and Figure – Jack Hamm
 5. Dynamic Anatomy – Burne Hogarth
 6. The artists complete guide to Human figure Drawing – Anthony Ryder
 7. Human Anatomy – Victor Perard
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