

CIVIL ENGINEERING

COURSES/CREDIT DISTRIBUTION OF CIVIL ENGINEERING DEPARTMENT

I. Basic Science Courses (BSC)

Semester I					
Course code	Course name	L	T	P	Credits
PYN 105	Mechanics	3	1	0	4
Semester II					
Course code	Course name	L	T	P	Credits
MAN102	Probability and Statistics	3	1	0	4
CHN 104	Physical Chemistry	3	0	3	4

II. Engineering Science Courses (ESC)

Semester II					
Course code	Course name	L	T	P	Credits
ESC101	Engineering Drawing	2	0	4	4
Semester III					
Course code	Course name	L	T	P	Credits
ESC103	Introduction to Manufacturing	2	0	4	4
Semester IV					
ESC206	Basics of Electrical Science	3	0	2	4

III. Departmental Core Courses (DCC)

Course code	Course name	L	T	P	Credits
CEN101	Introduction to Civil Engineering	2	0	0	2
CEN102	Building Construction and Estimation	3	1	0	4
CEN103	Fluid Mechanics	3	0	2	4
CEN201	Solid Mechanics	3	1	0	4
CEN202	Geoinformatics	3	0	2	4+2 (camp)
CEN203	Transportation Engg. I	3	0	2	4
CEN204	Environmental Engg. I	3	0	2	4
CEN205	Technical Communication	0	0	3	2
CEN206	Engineering Analysis and Design	3	1	0	4
CEN207	Structural Analysis I	3	0	2	4
CEN208	Reinforced Concrete Design	3	0	2	4
CEN209	Open Channel Hydraulics	3	0	0	4
CEN210	Geotechnical Engineering	3	0	2	4
CEN301	Design of Steel Structures	3	0	2	4
CEN302	Foundation Engg.	3	0	2	3
CEN303	Structural Analysis II	3	0	2	4
CEN304	Transportation Engg. II	3	1	0	4
CEN305	Environmental Engg II	3	0	2	4

IV. Departmental Elective courses (DEC)

Group-I (Any One)

Course code	Course name	L	T	P	Credits
CEN401	Irrigation Engg and Hydraulic Structures	3	1	0	4
CEN402	Construction Management	3	1	0	4
CEN403	Concrete Technology	3	0	2	4
CEN404	Engg. Geology	3	0	2	4

Group-II (Any Two)

(Specialisation I)

Course code	Course name	L	T	P	Credits
CEN405	Design of Reinforced Concrete Structures	3	0	2	4
CEN406	Earthquake Resistant Design and Detailing	3	1	0	4

CEN407	Advanced Steel Design .	3	0	2	4
CEN408	Advanced Structural Analysis	3	1	0	4

(Specialisation II)

Course code	Course name	L	T	P	Credits
CEN409	Transport Planning and Management	3	1	0	4
CEN410	Mass Transportation System	3	1	0	4
CEN411	Traffic Engg	3	1	0	4
CEN412	Economic Evaluation of Transportation Projects	3	1	0	4

(Specialisation III)

Course code	Course name	L	T	P	Credits
CEN413	Hydrology and Dams	3	1	0	4
CEN414	Flood Control and River Engg	3	1	0	4
CEN415	Hydro Power Engg	3	1	0	4
CEN416	Ground Water Hydraulics	3	1	0	4

(Specialisation IV)

Course code	Course name	L	T	P	Credits
CEN417	Industrial Waste Management	3	1	0	4
CEN418	Advanced Water and Waste Water Engineering	3	1	0	4
CEN419	Solid Waste Management	3	1	0	4
CEN420	Environmental Pollution and Management	3	1	0	4

V. Open Elective Courses (OEC)

Course code	Course name	L	T	P	Credits
CEN461	Clean Technology	3	1	0	4
CEN462	Disaster Mitigation	3	1	0	4
CEN463	Remote Sensing and GIS for Engineers	3	0	0	4

VI. Departmental Honors Courses (DHC)

Course code	Course name	L	T	P	Credits
CEN421	Bridge Engg.	3	1	0	4
CEN422	Advanced Structural Design	3	1	0	4
CEN423	Advanced Water Resources Engg.	3	1	0	4
CEN424	Advanced Environmental Engg.	3	1	0	4
CEN425	Advanced Transportation Engg.	3	1	0	4

VII. Minor Specialization Courses (MSC)

Course code	Course name	L	T	P	Credits
CEN431	Structural Analysis and Design	3	1	0	4
CEN432	Highways and Traffic Engg.	3	1	0	4
CEN433	Water Supply and Waste Water Treatment	3	1	0	4
CEN434	Water Resources Engg.	3	1	0	4
CEN435	Geomatics Engg	3	1	0	4

Course Name	:	INTRODUCTION TO CIVIL ENGINEERING
Course Code	:	CEN-101
Credits	:	2
L T P	:	2 0 0

Course Objectives:

On completion of this course, the student shall be introduced to an overview of Civil Engineering profession and the ethical responsibilities of engineering practice.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	STRUCTURAL ENGINEERING: Introduction to various aspects associated with analysis and design of various structural systems, Buildings, Bridges and other infrastructure projects.	8
2	HYDRAULICS/WATER RESOURCES ENGINEERING: Hydrological cycle, Flows in pipes and channels, Reservoirs/Dams, Hydro-power	5
3	GEOTECHNICAL ENGINEERING: Soil as construction material, Problems in plain and hilly areas, Earth retaining structures, Foundations for different types of structures, Embankments/ levees/earth and rockfill dams, Ground improvement techniques, Underground structures like tunnels, Shafts and caverns, Slopes engineering	3
4	TRANSPORTATION ENGINEERING: Fields of Transportation Engineering, Transportation Systems – Their suitability and utility, Transportation problems and roles of traffic engineers and transportation planners; Types of pavements, Pavement materials – conventional and new materials, Structure of a pavement, Airfield pavement	4
5	ENVIRONMENTAL ENGINEERING: Infrastructure required for water and wastewater Engineering	4
6	GEOMATICS ENGINEERING: Importance of surveying in Civil Engineering, Types of maps, Satellite images and aerial photographs, GPS survey, 3-D modeling, GIS applications in Civil Engineering projects	4

Course Outcomes: Upon completion of this course the student shall be able to

1	Make choice of career decisions
2	Apply concepts of ethics in professional practice

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Arora, M.K. and Badjatiya, R.C. "Geomatics Engg", Nem Chand and Bros., Roorkee	2009
2	Penn M. R. and Parker P. J. "Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering" John Wiley & Sons	2011
3	Mckay W. B. " Building Construction" Orient Longman	2003
4	Schodek D. L."Structures" Prentice Hall of India Pvt. Ltd.	2002

Course Name	:	BUILDING CONSTRUCTION & ESTIMATION
Course Code	:	CEN-102
Credits	:	4
L T P	:	3 1 0

Course Objectives:

To Introduce this subject at 2nd year or 3rd year civil level for B.E. Civil Engineering students to have the knowledge of Building Materials new B Materials and construction techniques with valuation of assets valuation is also important for every civil engineering in any of the field of civil engineering so tech this subject at 3rd year engineering level is more appropriate. As per the syllabus of UPSC Engg services. It is essential to teach U/G student

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO BUILDING MATERIALS Stones, Timber, Bricks, Cement, Manufacturing of Bricks & Cement, Concrete.	7
2	FOUNDATIONS Bearing capacity, Terms used, Spread, Pile, Well foundations, Grillage foundation and their suitability	4
3	BRICK MASONRY Brick Masonry: Terminology, Types of Bonds, English & Double Flemish Bond and their Merits & Demerits. Hollow Block Masonry, types of walls, viz., load bearing and non-load bearing walls.	4
4	DAMP PROOFING Causes of dampness in buildings, ill effects and Remedial measures, Damp Proofing, Methods of Damp Proofing, Cavity Walls.	3
5	DOORS, WINDOWS, LINTEL & ARCHES Terminology, Types of Doors and Windows & Types of Lintel and Arches.	4
6	FLOORS: Types of Floorings and their Construction Details.	3
7	STAIRS & STAIR CASES Terms used, Different Types of stair cases, proportioning, Dog-legged, half-turn and quarter turn stairs, classification of stair cases based on materials used.	3
8	ROOFS & ROOF COVERINGS Terms used, R.C.C. and Wooden roofs, pitched and sloping roofs, Trussed Roofs, Roof Covering Materials.	3
9	PLASTERING, POINTING AND PAINTING Plastering and pointing, Painting and Distempering	2
10	FORMWORK AND SCAFFOLDING Introduction to Formwork and Scaffolding	1
11	RATE ANALYSIS AND ESTIMATION Rate analysis of materials & labour Types of Estimates, Detailed Estimate of Two Room Building Quantities of Earth work in roads & Canals.	8

Course Outcomes: Upon completion of the course the student shall be able to:

1	Choose the appropriate building materials for a particular civil engineering structure
2	Supervise the different construction operations
3	Estimate the cost of construction

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Building Construction Punmia B.C, Arun Jain & Ashok Jain, “Building Construction” Laxmi publication	2012
2	Dutta B.N, “ Estimation and costing in Civil Engineering”, UBS publisher	2014
3	Varghese P.C. “Building Materials”, PHI learning Pvt Ltd.	2014
4	Varghese P.C. “Building Construction”, PHI learning Pvt Ltd.	2014

5	Mckay W. Barry, "Building Construction", Pearson Publication	2013
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Course Name	:	FLUID MECHANICS
Course Code	:	CEN 103
Credits	:	4
L T P	:	3 0 2

Course Objectives:
At the end of this course, the student would be able to learn the basic concept of fluid mechanics. To understand the analytical method of solving fluid mechanics problem.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Fluids, Brief history of Fluid Mechanics, Properties of Fluid, Viscosity, Capillarity, Surface Tension, Compressibility, Normal and Shear Stresses in Fluid Flows, Regimes of Flow, Laminar Flow, Turbulent Flow and Rotational Flow.	4
2	FLUID STATICS Pascal's Law of measurement of pressure, Types of forces on a fluid system, manometers and gauges, forces on partially and fully submerged bodies including that on curved surfaces, Buoyancy, stability of floating bodies, centre of gravity, Metacentric height.	6
3	KINEMATICS OF FLUID FLOW Langrangian and Eulerian methods, description of properties in a moving fluid, local and convective acceleration, Streamlines, Path lines, Streak lines, Laplace equation, Stream function, velocity potential and flownets.	4
4	DYNAMICS OF FLUID FLOW Equation of conservation of mass, differential form of continuity equation. External forces, Euler's equation of motion, Bernoulli's equation, simple application to one dimensional flow, linear momentum and angular momentum, momentum theorem, moment of momentum theorem	8
5	VISCOUS FLOW Pressure gradient in steady uniform flow, flow between parallel plates, Qualitative aspects of viscous flows, Hagen-Poiseulli's flow, Transition from laminar to turbulent flow, turbulent flow in circular pipe, Navier Stokes equation (without derivation).	5
6	FLOW THROUGH PIPES Introduction, energy and hydraulics grade line, non-dimensional formulation of the pipe flow problem, head losses in pipes & pipe fittings, pipe in series & parallel, reservoir problem.	5
7	DIMENSIONAL ANALYSIS AND SIMILITUDE Buckingham's Theorem, non-dimensional groups, Reynold's Number, Geometric, Kinematic and Dynamic Similarity, Hydraulic Models.	4
8	FLOW MEASUREMENT Venturimeter, orifice meter, Pitot tube, Orifices, mouth pieces, notches, weirs, Current meter.	6

List of Experiments:		Number of Turns
1	To measure the Flow Velocity by Orifice Meter	2
2	To measure the Flow Velocity by Venturimeter	2
3	To measure the Flow Velocity by V Notch	2
4	Computation of various coefficients involving in through orifice.	1
5	Determination of Minor losses in pipes	2

6	Determination of friction factors of pipes	2
7	Verification of Bernoulli's theorem	2
8	To determination of the metacentric height of a given vessel under unloaded condition.	1

Course Outcomes:

1	By the end of this course, the student will be able to apply the techniques learned in the course for solving real life problems related to fluid mechanics.
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Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Engineering Fluid Mechanics", R.J. Garde and A.G. Mirajgaonkar, Nem Chand and Bros.	1980
2	"Fluid Mechanics", Frank M. White, McGraw Hill.	1979
3	"Elementary Mechanics of Fluids", H. Rouse, John Wiley	1949
4	"Fluid Mechanics", Streeter, V.L., McGraw Hill Co	1998
5	"Experimental Fluid Mechanics-Volume I", G.L. Asawa, Nem Chand & Brothers	1992
6	"Experiments in Fluid Mechanics-Second Edition", S. Singh, PHI Publications	2013

Course Name	:	SOLID MECHANICS
Course Code	:	CEN 201
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course, the student should be able to identify and analyse the basic structural elements and apply the concepts of analysis for the design of various civil engineering structures.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	PROPERTIES OF MATERIALS Introduction, tensile test, idealized stress- strain diagrams, isotropic, linear, elastic, visco-elastic and plastic materials, compression test, impact test, fatigue test, torsion and bending test.	3
2	SIMPLE STRESSES AND STRAINS Concept of stresses and strains, relationship between elastic constants, extension of uniform bar and tapered bar under its own weight and due to load, stresses produced in compound bars due to axial loads, thermal stresses.	4
3	COMPOUND STRESSES General state of stress, resultant stress and strain, principal stresses and principal strains, Mohr's circle for compound stresses and strains.	4
4	SHEAR FORCE AND BENDING MOMENT IN BEAMS Types of loads, Shear force, bending moment, Relation between load, SF and BM, SFD, BMD and axial force diagram for determinate beams under various types of loading.	5
5	BENDING AND SHEAR STRESSES IN BEAMS Pure bending, bending stresses, combined bending and direct stresses, Middle Third rule, composite beams, Variation of shear stresses for various cross-sections of a beam.	5
6	ANALYSIS OF PLANE TRUSSES Different types of trusses, Analysis of plane determinate trusses by method of joints, method of sections and graphical method.	5
7	TORSION	4

	Torsion equation for circular shaft, shafts under action of varying torque, torsion of composite shafts.	
8	COLUMNS AND STRUTS Criteria for stability of columns, Buckling of columns, Euler's formula for various end restraints, Rankine's formula, eccentrically loaded struts, struts with initial curvature, struts with lateral loading.	4
9	DEFLECTION OF BEAMS Slope and Deflection in beams by double integration method, Macaulay's method and Moment area method; slope and deflection in built in and propped beams.	5
10	FAILURE THEORIES Theories of failure: maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, distortion energy theory, comparison of the failure theories.	3

Course Outcomes: By the end of this course the student will be able to:

1	Identify different materials and their behaviour
2	Analyse various civil engineering structures under different loading conditions
3	Apply the principles of structural mechanics in design structural elements
4	Apply the concepts of failure theories for design of structures

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Strength of Material", G.H. Ryder, MacMillan Publishers India Ltd.	2002
2	"Mechanics of Materials", E.J. Hearn, Elsevier Publications.	2001
3	"Mechanics of Materials", Punmia and Jain, Laxmi Publications (P) Ltd.	2013
4	"Mechanics of Materials", R.C.Hibbeler, Pearson Higher Education.	2013
5	"Strength of Materials", S. Ramammurtham and R. Narayanan, Dhanpat Rai Publishing Company.	2014

Course Name	:	GEO-INFORMATICS
Course Code	:	CEN 202
Credits	:	4
L T P	:	3 0 2

Course Objectives:

At the end of this course, the student should be able to learn the basic concepts of surveying and apply the knowledge in preparation of maps. The student will be able to appreciate the use of remote sensing and GIS in Civil Engineering practice.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO SURVEYING AND MAPPING Maps, Map Scales, Map Numbering Systems, Principles and Classification of surveying, Linear and Angular measurements. Compass and Theodolite. Errors in measurements. Methods of Control Establishment.	5
2	LEVELLING: Basic Definition, Methods of Levelling, Classification of Levelling, Level & Levelling staff, Basic Principles of Levelling, Methods for Reducing Levels.	4

3	TACHOMETRIC SURVEYS: Principle of Tacheometry, Methods of Tacheometry, Instruments. Tacheometric Computations. Uses of Tacheometry.	3
4	TRAVERSE COMPUTATION: Selection of Traverse Station, GALE'S Traverse Table, Checks in Traverse, Calculation of Independent Co-ordinates	3
5	PLANE TABLE SURVEYS AND CONTOURING Principles of Plane Table surveys, Methods of Plane Tabling. Contouring: Characteristics of Contours, Methods of Plotting Contour. Detail plotting and Contouring using Plane Table Surveys	5
6	TOTAL STATION (TS) SURVEYS Introduction to total station, Advantages of TS,	2
7	GPS SURVEYS Introduction to GPS surveys, Segments of GPS, Applications of GPS	3
8	CURVES AND CURVE LAYOUT Definitions & Notations, Designation of Curve, Element and setting out of Simple Circular Curve and Compound Curve	4
9	INTRODUCTION TO PHOTOGRAMMETRY Basics of Photogrammetry, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, Relief displacement.	3
10	INTRODUCTION TO REMOTE SENSING (RS) Basic RS, Interaction with atmospheric and earth surface, Platforms and sensors. RS Data Products, Resolution, Applications of Remote Sensing.	5
11	INTRODUCTION TO GEOGRAPHICAL INFORMATION SYSTEM (GIS) Definition of GIS, Vector and raster data, database creation, Digital Elevation Model (DEM), Applications of GIS	5

Course Outcomes: By the end of this course, the student will be able to:

1	Apply the concepts and analytical methods related to Surveying
2	Use the various surveying equipment.
3	Plan and execute surveying projects.
4	Prepare a Topographical map and concepts of 3 D view.
5	Identify the potential use of Remote Sensing and GIS in Civil Engineering

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Geomatics Engineering”, Arora & Badjatia, Nem Chand & Bros., Roorkee	2011
2	“Surveying Vol. I & II”, B.C. Punmia, A.K. Jain & Jain. Luxmi Publications (P) Ltd., New Delhi	2006
3	“Surveying Vol. II”, S.K.Duggal: Tata McGraw Hill, New Delhi	2009
4	“Surveying and Levelling”, Subramanian, Oxford university press	2012
5	“Surveying and Levelling”, N N Basak, McGraw Hill	2014
6	“Surveying Vol II & III”, K.R. Arora, Standard Book House, New Delhi.	2010

Course Name	:	TRANSPORTATION ENGINEERING – I
Course Code	:	CEN 203
Credits	:	4
L T P	:	3 0 2

Course Objectives:

At the end of this course, the student should be able to learn the basic aspects of road infrastructure including planning, design and maintenance.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Highway planning - basic principles, road development and planning in India; Highway alignment and Surveys	4
2	GEOMETRIC DESIGN OF HIGHWAYS Design of cross-section elements, sight distances, design of horizontal and vertical alignments	8
3	TRAFFIC STUDIES Traffic studies and their presentation, PCU and axle load survey, Capacity and Level of service, highway safety measures	8
4	HIGHWAY MATERIALS AND CONSTRUCTION Aggregates and their characterization, Bituminous materials, tests on Aggregates and Bituminous materials; Construction Procedure for WBM, Bituminous Bound macadam and Cement Concrete roads	6
5	PAVEMENT DESIGN Classification of pavements and factors affecting design; Design methods of flexible pavements and of Rigid pavements	6
6	HIGHWAY DRAINAGE Longitudinal and cross drainage, Surface and subsurface drainage	3
7	HIGHWAY BRIDGE Types of bridges, components, selection criteria	3
8	HIGHWAY MAINTENANCE General causes of pavement failure, failures in flexible and rigid pavements and their maintenance	4

List of Experiments:		Number of Turns
1	To find out crushing strength of road aggregates	1
2	To find out hardness of road aggregates	1
3	To find out toughness of road aggregates	1
4	To find out the durability of road aggregates	1
5	To find out the shape and size of road aggregates	1
6	To determine the hardness of bitumen	1
7	To determine the ductility of bitumen	1
8	To determine the softening of bitumen	1
9	To determine the viscosity and specific gravity of bitumen	1
10	To determine the CBR value of soils and aggregate	2
11	To carry out traffic volume study	1
12	To carry out traffic speed study	1
13	To carry out traffic parking study	1

Course Outcomes: By the end of this course, the student will be able to:	
1	Identify the components of highways
2	Plan, design and execute highway projects
3	Choose the suitable material for highways
4	Conduct and interpret the results of traffic studies
5	Supervise the construction and maintenance of highways.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Highway Engineering”, S.K. Khanna, C.E.G. Justo and A. Veeraraghavan , Nem Chand & Brothers, Roorkee	2014
2	“Principles & Practices of Highway Engineering”, L.R. Kadiyali and N.B. Lal, Khanna Publishers, New Delhi	2013
3	“Highway Material Testing Manual”, S.K. Khanna, C.E.G. Justo and A. Veeraraghavan, New Chand Publications, New Delhi	2009
4	“Principles, Practice and Design of Highway Engineering”, S.K. Sharma, S. Chand Publication	2012
5	“Transportation Engineering and Planning”, C.S. Papacostas and P.D. Prevedouros, PHL Learning Private Limited, New Delhi	2012

Course Name	:	ENVIRONMENTAL ENGINEERING - I
Course Code	:	CEN 204
Credits	:	4
L T P	:	3 1 0

Course Objectives:
At the end of this course, the student should be able to identify various environmental issues related to water, air and noise. The student will be able to analyse the systems and prepare engineering designs. They will also be able describe the concepts and practice of EIA as environmental management tool.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Introduction to environmental engineering, issues related to different spheres of the environment, global issues, climate change, engineering solutions	2
2	WATER Water Supply systems, Need for planned water supply schemes, Sources of Water, choice of the sources, water demand, demand estimation	2
3	COMPONENTS OF WATER SUPPLY SYSTEM Collection and conveyance of water: intakes, pumps and pipes; selection and design	6
	Quality of water: testing, physical, chemical and bacteriological parameters, standards	4
	Treatment of water: unit processes and operations, sedimentation, coagulation and flocculation, filtration, disinfection, miscellaneous treatments, process and design	9
	Distribution system: system components, service reservoirs, use of design software like ‘EPANET’, ‘WaterNet’, ‘WaterGem’.	5
	Operation and Maintenance, Instrumentation and control	2
4	AIR Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution, automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, equipment and strategies for Air pollution Control.	6
5	NOISE Basic concept, measurement and various control methods.	3
6	ENVIRONMENTAL IMPACT ASSESSMENT	

	Concepts, various stages, Environmental Audit- Life Cycle Assessment, ISO 14000, ISO 18000	3
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Course Outcomes: By the end of this course the student will be able to:	
1	Apply the process concepts in the design of water supply systems
2	Design distribution system, use the analytical tools including relevant software
3	Supervise the operation and maintenance of water supply systems
4	Describe the strategies and control of air and noise pollution
5	Identify and apply concepts of EIA in engineering projects

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“CPHEEO, Manual of Water Supply and Treatment – 3 rd Edition”, Ministry of Urban Development, Govt. of India.	2003
2	“Water Supply Engineering”; Verma, Kanwar and John, Vikas Publications, N Delhi	2014
3	“Water Works Engineering”, S.R. Qasim, E.M. Motley & G.Zhu, PHI (EEE Edition), New Delhi	2010
4	“Water and Wastewater Technology”, Hammer, M.J. and Hammer, M.J., Prentice Hall of India.	2008
5	“Introduction to Environmental Engineering” Vesilind, P A and Morgan, S M, THOMSON Books, NY	2008
6	“Environmental Engineering” Peavy, H S; Rowe, D R and Tchobanoglous G. McGraw Hill, NY	1985 (online)

Course Name	:	ENGINEERING ANALYSIS AND DESIGN
Course Code	:	CEN 206
Credits	:	4
L T P	:	3 1 0

Course Objectives:
At the end of this course, the student should be able to learn the basics of engineering design and different techniques of data analysis.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	ENGINEERING PLANNING AND DESIGN Introduction, Planning and design as problem-solving processes, Engineering planning and design process, Problem formulation phase Feasibility study and concept of design	4
2	REVIEW OF STATISTICS Distribution of sampling statistics, parameters estimations, statistical models, Data display, data Analysis.	6
3	RISK AND RELIABILITY ANALYSIS Measures of reliability, uncertainty in reliability assessments, Reliability limits, Bayesian revision of reliability, Hazard function	6
4	OPTIMIZATION Introduction, One-Dimensional Unconstrained Minimization, Theory Related to Single Variable (Univariate) Minimization, Unimodality and Bracketing the Minimum, Fibonacci Method, Golden Section Method, Polynomial-Based Methods, Shubert–Piyavskii Method for Optimization of Non-unimodal Functions, Zero of a Function.	6

5	UNCONSTRAINED OPTIMIZATION Necessary and Sufficient Conditions for Optimality, Convexity, Basic Concepts: Starting Design, Direction Vector, and Step Size, The Steepest Descent Method, The Conjugate Gradient Method, Newton's Method, Quasi-Newton Methods, Approximate Line Search.	8
6	TIME SERIES Stochastic Process, Autocovariance and auto correlation functions, Partial autocorrelation function, White noise processes, Moving average and autoregressive representations.	8
7	SIMULATION Random Numbers, The Bootstrap Method, Generating Discrete Random Continuous and Normal Random Variables, Simulation models.	4

Course Outcomes: By the end of this course the student will be able to:	
1	Plan and design engineering problems applying analytical methods
2	Apply the concepts of statistics, risk and reliability in engineering decision making
3	Provide optimum solutions to engineering problems
4	Simulate and model engineering problems

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Applied Statistics for civil and Environmental Engineers", Nathabandu T. Kottegoda and Renzo Rosso, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom	2008
2	"Probability Models in Engineering and Science", Haym Benaroya and Seon Mi Han, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742 2005, USA	2005
3	"Simulation Modeling and Analysis", Averill M. Law and W, David Kelton, McGraw Hill Publications, New York, USA	2006
4	"Numerical Analysis and Optimization", Grégoire Allaire, Oxford University Press, Great Clarendon Street, Oxford OX2 6DP Oxford, New York USA	2007

Course Name	:	STRUCTURAL ANALYSIS - I
Course Code	:	CEN 207
Credits	:	4
L T P	:	3 0 2

Course Objectives:	
At the end of this course, the student should be able to learn the behaviour of civil engineering determinate structures under static and moving loads by analytical/experimental techniques and software tools. The student should also be able to acquire the ability to interpret and evaluate experimental results.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	TRAVELLING LOADS Maximum Shear Force and Bending Moment diagrams for simply supported beams carrying following moving loads:- i) A Single Concentrated Load ii) Uniformly Distributed Load iii) Two Concentrated Loads fixed distance apart iv) Series of Concentrated Loads Enveloping parabola, equivalent udl for BM and SF in each of the above cases.	7

2	INFLUENCE LINES Influence lines for reactions, BM & SF for simply supported beam and panelled girders. Influence lines for forces in trusses with top horizontal and curved both, reversal of stresses, use of influence lines for calculating design forces due to dead load and moving live loads. Influence lines using Muller Breslau principle, Maxwell's reciprocal theorem.	7
3	ARCHES Three hinged arches, BM, radial shear and normal thrust at any section of a parabolic and segmental arch due to simple cases of loading. Moving loads on three hinged arches. Change in rise of the arch due to change in temperature. Three hinged spandrel braced arches subjected to static and moving loads.	6
4	SUSPENSION BRIDGES Un-stiffened suspension bridges, maximum tension in the suspension cable and backstays, pressure on towers.	5
5	DEFLECTION OF BEAMS Deflection of determinate beams using unit load method and Castigliano's theorem I method.	4
6	DEFLECTION OF PERFECT TRUSSES Deflection of joints in trusses subjected to static loading by Castigliano's strain energy theorem method, Unit load method and Williot Mohr diagram method.	4
7	SPACE FRAMES Analysis of space frames by method of tension coefficients and by equilibrium method.	5
8	INDETERMINATE STRUCTURES Introduction to Indeterminate Structures, Determination of kinematic and static indeterminacy of beams, frames and trusses. Introduction to methods of analysis of indeterminate structures.	4

List of Experiments:		Number of Turns
1	To perform tension and compression test for steel.	1
2	To perform bending and shear test for steel.	1
3	To study the behaviour of columns and struts under different end conditions.	1
4	To verify Maxwell's Reciprocal Theorem.	1
5	To study the behaviour of three hinged arch.	1
6	To determine deflection of curved beams.	1
7	To determine deflection of trusses.	1
8	To verify moment area theorem regarding slope and deflection in a beam	1
9	To study various commands of the software for analysis of structures	2
10	To analyse simple beams using software	2
11	To analyse continuous beams using software	2

Course Outcomes: By the end of this course the student will be able to:	
1	Formulate equilibrium and compatibility equations for structures
2	Analyse determinate structures for static and moving loads using classical methods
3	Analyse and assess the behaviour and serviceability of the structures using analytical/experimental methods
4	Apply software tools for the analysis of structures.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Theory of Structures (Vol. II)", B C Punmia, Laxmi Publications.	2005
2	"Structural Analysis", R.C. Hibbeler, Prentice Hall of India Pvt. Ltd.	2011
3	"Structural Analysis", T.S. Thandavamoorthy, Oxford University Press.	2011
4	"Theory of Structures", S. Ramamrutham & R. Narayan, Dhanpat Rai.	2014

5	“Structures” Daniel & Martin, Prentice Hall of India Pvt. Ltd.	2009
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Course Name	:	REINFORCED CONCRETE DESIGN
Course Code	:	CEN 208
Credits	:	4
L T P	:	3 0 2

Course Objectives:
At the end of this course, the student should be able to design various RCC structural elements and to perform quality tests on constituent materials of concrete.
The student should also be able to work with others in professional settings.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	PROPERTIES OF CONCRETE Materials for concrete and their properties, concrete as composite material, properties of concrete in fresh and hardened state, workability, strength and durability, factors affecting workability, strength and durability, Indian Standard method of proportioning concrete mixes.	5
2	REINFORCED CONCRETE Design Loads, design philosophies, Working Stress method, Ultimate load method and limit state method of design, characteristic strength, characteristic load, design values and partial safety factors, stress strain relationship for concrete and steel.	4
3	DESIGN AND DETAILING OF BEAMS Singly reinforced beams, modes of failure, moment of resistance and design of beams for flexure, analysis and design of doubly reinforced and flanged beams. Shear, bond, torsion. Limit state of serviceability, control of cracking, deflection and vibrations, design of continuous beams by co-efficient method as per IS code. Introduction to design of beams using software.	8
4	DESIGN AND DETAILING OF SLABS One way slabs, two way slabs, continuous slabs.	4
5	DESIGN OF COLUMNS Types of columns, short columns, long columns, columns with helical reinforcement.	5
6	FOUNDATIONS Design concepts of isolated and combined rectangular footings, design of masonry walls and their footings	5
7	STAIR CASES Design of different type of stairs.	3
8	RETAINING WALLS Types of retaining walls, stability criteria, design of cantilever retaining walls.	4
9	PRE STRESSED CONCRETE Introduction to prestressed concrete, methods of prestressing, losses of prestress, analysis of simple prestressed beams.	4

List of Experiments:		Number of Turns
1	To determine fineness of cement.	1
2	To determine standard consistency of cement paste.	1
3	To determine initial and final setting time of cement.	1
4	To conduct soundness test on cement.	1
5	To determine specific gravity of cement.	1
6	To determine compressive strength of cement.	2

7	To determine fineness modulus and grain size distribution of fine and coarse aggregates.	1
8	To determine bulk density and voids of fine and coarse aggregates.	1
9	To determine workability of concrete.	1
10	To design concrete mixes.	2
11	To assess the quality of concrete by conducting Non Destructive Tests.	2

Course Outcomes: By the end of this course the student will be able to:

1	Assess the quality of concrete making materials
2	Conduct quality control tests on concrete
3	Design and test concrete mixes as per relevant standard codes
4	Design RCC structures and prepare the detailed structural drawings for execution purpose

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Plain & Reinforced Concrete (Vol. I & Vol-II)", Jain & Jai Krishan, Nemchand and Bros.	2007
2	"Reinforced Concrete Design", S.U. Pillai & Devdas Menon' Tata McGraw Hill Publications.	2005
3	"Reinforced Concrete Limit State Design" A.K.Jain, Nem Chand and Bros.	2012
4	"Limit State Design of Reinforced Concrete", Punmia and Jain (Vol.II), Laxmi Publications.	2007
5	Code of Practice for Plain And Reinforced Concrete Design, IS:456-2000.	2000
6	"Prestressed Concrete", N.Krishna Raju, Tata McGraw Hill	2006
7	"Concrete Technology", M. L. Gambhir, Tata McGraw Hill.	2014

Course Name	:	OPEN CHANNEL HYDRAULICS
Course Code	:	CEN-209
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course, the student should be able to learn the physical flow processes and their mathematical descriptions. The students will be able to analyse and design canals and hydraulic structures

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
	INTRODUCTION	4
1	Definition of Open channel flow, Comparison between Open Channel flow and Pipe Flow, Types of Channels, Classification of flow, Velocity Distribution, One Dimensional Method of flow analysis, Pressure distribution, Equation of continuity.	
	UNIFORM FLOW	4
2	Its properties and basic resistance equations, Variation of roughness coefficient, Conveyance of Channel, Section factor and normal depth, Most efficient flow section-rectangular, triangular, trapezoidal and circular.	
	ENERGY, MOMENTUM EQUATIONS AND CRITICAL FLOW	6
3	Energy and specific energy in an open channel, properties of critical flow, critical depth for rectangular and trapezoidal channel, alternate depth, application of specific energy to transition and broad crested weir, momentum and specific force in an open channel, channel control, specific energy and specific force curve.	
4	GRADUALLY VARIED FLOW – THEORY AND LIMITATION	5

	Classification of water surface profile and channel slopes, profile computations methods, free overfall, Numerical Solution of Steady Gradually Varied Flow Equations.	
5	RAPIDLY VARIED FLOW Hydraulic jump, its location, control and stabilization, characteristics of hydraulic jump in rectangular channel, Loss of energy in hydraulic jump, Flow over spillways.	5
6	UNSTEADY FLOW Basic Equation, Uniformly Progressive Wave, Surges, Saint Venant Equations.	4
7	FLUVIAL HYDRAULICS AND FLOW MEASUREMENTS Shields diagram, regimes theories and applications, resistance to flow in mobile bed channels regime channels and design aggradation and degradation of alluvial streams, bridge and abutment, flow over spillways, sluice gates	9
8	HYDRAULIC MACHINES Introduction to Pumps and turbines, Heads and efficiencies of turbine and pumps, Classification of Hydraulic Turbines and pumps, components of Turbines and Pumps, Euler Turbine equation, Components of Power Produced.	5

Course Outcomes: By the end of this course, the student should be able to:	
1	Formulate mathematical description of open channel flow problems
2	Analyse flow patterns in open channels
3	Design canals and hydraulic structures
4	Identify the different types of hydraulic machines and describe their characteristics.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Open Channel Hydraulics”, V.T. Chow, McGraw Hill	2009
2	“Flow in Open Channel”, K. Subramanya TMH, Publication Co. Ltd.	2013
3	“A textbook of Fluid Mechanics and Hydraulic Machines”, R.K.Rajput, S.Chand & Company Pvt. Ltd.	2013
4	“Flow through Open Channel”, K.G. Rangaraju TMH, Publication Co. Ltd.	2013
5	“ The Hydraulics of Open Channel Flow: An Introduction”, Chanson, H., Elsevier	2004
6	“Open Channel Hydraulics”, Terry Sturm, Tata McGraw Hill Pub.,	2011

Course Name	:	GEOTECHNICAL ENGINEERING
Course Code	:	CEN 210
Credits	:	4
L T P	:	3 0 2

Course Objectives:	
At the end of this course the student will be able to explain formation rock and soil along with their properties and will be able identify them. They will also be able to formulate and analyse development of stresses in soil and rock in field situation.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	GEOLOGICAL ASPECTS Role of Engineering Geology in Civil Engineering, Materials of Earth, Rock forming silicates, Physical properties of minerals.	3

	Geological work of rivers and glaciers	2
2	STRUCTURAL FEATURES Structural features of rocks-Folds, Joints, Faults and their Engineering Considerations.	3
3	TECTONICS Earthquake and earth movement-Causes & preventive measures.	3
4	CIVIL ENGINEERING APPLICATIONS Geological factors affecting the construction of dams, reservoir & tunnels	3
5	INTRODUCTION TO SOIL Origin, classification and phase relationship in soils, soil structure and clay minerals, Effective stress principle ,effective stresses under hydrostatic & one-dimensional flow condition	4
6	PERMEABILITY Factors affecting permeability, Lab and field determination methods, Seepage Pressure, Quick Sand Condition, Critical void ratio, filter media.	4
7	CONSOLIDATION Compressibility, Consolidation, Terzaghi's one dimensional Consolidation Theory, Time Factor and Degree of consolidation, Computation of settlement, Consolidation Test, Square root time fitting method and logarithmic time fitting methods , NC & OC Clays, Vertical Sand Drains.	5
8	SHEAR STRENGTH Shear strength parameters-Total stress and effective stress, Factors affecting strength, Drainage Condition and Pore water pressure, UCS, Mohr's circle, Failure Envelope, Direct shear test, Triaxial shear test.	5
9	COMPACTION Standard and modified Proctor's test , Field control of compaction, Different types of field compaction equipment and their suitability for compaction process.	2
10	EARTH PRESSURE Concept of lateral earth pressure; Active, passive and earth pressure at rest; Rankine's and Coloumb's theories, Earth pressure computation in different soils and surcharge load, Rebhnann's and Culmann's construction. Design considerations of earth retaining structures.	4
11	SITE EXPLORATION Objects of soil investigation for new and for existing structures, method of soil exploration with relative merits and demerits, depth and spacing of boreholes, soil sampling, SPT and plate load test, Bore-hole Logs.	4

List of Experiments:		Number of Turns
1	To determine grain size distribution by Sieve analysis	1
2	To conduct Specific gravity test by Pycnometer	1
3	To determine In-situ density using Sand Replacement method	1
4	To Determine Liquid limit and Plastic limit	1
5	To Determine shrinkage limit	1
6	To determine coefficient of permeability by falling head method	1
7	To determine coefficient of permeability by constant head method	1
8	MDD and OMC by Standard Proctor compaction test	1
9	To determine shear strength parameters by Direct Shear Test	1
10	To perform Unconfined Compression Test	1
11	Tri-axial Shear Test	1
12	Identification of Rocks and Minerals	1
13	Study of symmetry of crystals	1
14	Slack Durability Test	1

Course Outcomes: By the end of the course, the student will be able to:	
1	Identify the type of rock and soil

2	Characterise and classify soils
3	Identify and analyse the properties of soil governing its behaviour
4	Apply the principles of soil mechanics in design of earth retaining structures and foundations
5	Perform failure analysis of structures under shear failure and excessive settlement.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Engineering and General Geology”, Parbin Singh, S.K. Kataria & Sons, Delhi	2012
2	“Principles of Engineering Geology”, KVGK Gokhale, B S Publications	2005
3	“Principles of Geotechnical engineering”, Braja. M. Das, Cengage Learning, New Delhi	2009
4	“Basic and Applied Soil Mechanics”, Gopal Ranjan & A.S.R. Rao. New Age International Publishers	2006
5	“Soil Mechanics”, T. William Lambe & Robert V. Whitman, John Wiley & Sons, NY	2008
6	“Soil Mechanics and Foundations”, Muni Budhu, John Wiley & Sons	2010

GENERAL SCIENCE COURSES (GSC)

Course Name	:	ENVIRONMENTAL SCIENCES
Course Code	:	GSC101
Credits	:	3
L T P	:	3 0 0

Course Objectives:

This course aims to acquaint students with the basics of Environmental Sciences.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Multi-discipline nature of environmental studies as applied to different engineering streams - Definitions, scopes and explanations.	6
2	Types of Ecosystems – System dynamics – Understanding ecosystems, Ecosystem degradation, Resource utilization, Ecosystem diversity, Habitat classification.	6
3	Natural Resources; Renewable and non-renewable- Natural resources and associated problems, Non-renewable resources, Renewable resources	6
4	Energy and Environment- Fossil fuel, Geothermal, tidal, nuclear, solar, wind, hydropower & biomass.	6
5	Environment pollution- Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear hazards	6
6	Cleaner Production and life cycle analysis: - LCA methodology, steps and tools, EIA and Environment audit	6
7	Environment Development and Society:- Emerging technology for sustainable development and environment management, public participation and provision in management and legislation.	6

Course Outcomes:

1	Students will be able to relate the importance of Environmental Sciences for sustainable development of society.
2	Students will be able to understand the problems and remedies of Environmental Sciences.

Text Books:

Sr. No.	Name of Book/ Authors/ Publisher
1	Environmental Science Ceonage Learning Publication, Miller G.T. and Spool Mar
2	Environmental Studies, Tata McGraw Hill Pub., Banny Joseph

BASIC SCIENCE COURSES (BSC)

Course Name	:	MATHEMATICS I
Course Code	:	MAN 101
Credits	:	4
L T P	:	3-1-0

Course Objectives:
To make the students understand the behavior of infinite series and their use.
To make the students learn the concepts related to functions of several variables and their applications.
To make the students learn the methods of evaluating multiple integrals and their applications to various problems.
To make the students learn the methods to formulate and solve linear differential equations and apply them to solve engineering problems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INFINITE SERIES Infinite series and convergence, alternating series, power series and convergence. Taylor's and Maclaurin's Series. (Scope as in Chapter 8, Sections 8.1, 8.3 – 8.9 of Reference Book 1).	8
2	MULTIVARIABLE FUNCTIONS Limit, Continuity and Partial Derivatives; Euler's Theorem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor's Formula. (Scope as in Chapter 12, Sections 12.1 – 12.6, 12.8 – 12.10 of Reference Book 1).	10
3	SOLID GEOMETRY Cylinders and Quadric surfaces, Cylindrical and Spherical Coordinates. (Scope as in Chapter 10, Sections 10.6 and 10.7 of Reference Book 1)	4
4	INTEGRAL CALCULUS Area between plane curves; Volumes of solids of revolution; Lengths of plane curves; Areas of surfaces of revolution. Double integrals in rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical coordinates, Substitutions in Multiple Integrals. (Scope as in Chapter 5, Sections 5.1, 5.3, 5.5, 5.6 and Chapter 13 .Sections 13.1, 13.3, 13.4,13.6 and 13.7 of Reference Book 1).	8
5	ORDINARY DIFFERENTIAL EQUATIONS First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian. (Scope as in Chapter 1, Section 1.5, 1.8 Chapter 2, 2.1-2.4, 2.6, 2.9-2.10, 2.13- 2.15 of Reference Book 2).	12

Course Outcomes:	
1	The students are able to test the behavior of infinite series.
2	The students are able to analyze functions of several variables and their applications.
3	The students are able to evaluate multiple integrals and apply them to practical problems.
4	The students are able to solve linear differential equations.

Reference Books:	
Sr. No.	Name of Book/ Authors/ Publisher
1	G. B. Thomas, R. L. Finney. Calculus and Analytic Geometry, Ninth Edition, Pearson Education.
2	E. Kreyszig. Advanced Engineering Mathematics, Eighth Edition, John Wiley.
3	B. V. Ramana. Higher Engineering Mathematics, Tata McGraw Hill.

Course Name	:	PROBABILITY AND STATISTICS
Course Code	:	MAN 103
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to use statistical methods to collect and analyze the data. The students should be able to estimate unknown parameters of populations and apply the tests of hypotheses.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS Random variables, Discrete, Continuous and Joint Probability distributions, Marginal and Conditional distributions, Independent random variables, Expectation, Variance and Covariance, Means and variances of linear combinations of random variables, Chebyshev's inequality, Binomial, Poisson, Uniform and Normal distributions, Normal and Poisson approximations to Binomial, Moments, Moment generating function.	20
2	SAMPLING DISTRIBUTIONS & ESTIMATION Population, Sample, Sampling distributions, Law of large numbers, Central limit theorem, Distribution of sample mean, Difference of means, Proportions and difference of proportions, Chi-square distribution, Student's t-distribution, Estimation of parameters, Point estimate, Confidence interval for mean, difference of means and proportions.	16
3	TESTS OF HYPOTHESES Hypothesis, Test statistic, Critical region, Significance level, Single Sample and Two Samples tests for mean.	6

Course Outcomes: By the end of this course, the student will be able to:

1	Collect and analyze the data statistically.
2	Describe sampling distributions of sample means and sample proportions
3	Estimate unknown parameters of the population from a sample.
4	Construct confidence intervals for mean difference of means and proportions; and perform hypothesis tests for means.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Probability and statistics for Engineers and Scientists, Walpole, Myers, Myers and Ye, Pearson Education	2012
2	Introduction to Mathematical Statistics, Hogg and Craig, Pearson Education	2013
3	Miller and Freund's: Probability and Statistics for Engineers, Richard A. Johnson, Prentice Hall	2010
4	John E. Freund's: Mathematical statistics with Application, Miller and Miller, Pearson Education	2012

Course Name	:	VECTOR CALCULUS, FOURIER SERIES AND LAPLACE TRANSFORM
Course Code	:	MAN105

Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to use concepts of vector calculus to analyze scalar and vector fields and compute the gradient, divergence and curl. They should be able to evaluate line, surface and volume integrals. The students should be able to expand functions in a Fourier series and apply Harmonic analysis to numerical data. They should be able to evaluate Laplace transforms and inverse Laplace transform and apply Laplace transforms to solve ordinary differential equations.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	VECTOR CALCULUS Gradient, Divergence and Curl – their physical interpretation and representation in cylindrical and spherical coordinates. Line, surface and volume integrals; Green’s theorem in the plane, Stoke’s theorem, Divergence theorem; Irrotational and Solenoidal Fields, Applications to Science and Engineering.	20
2	FOURIER SERIES Periodic functions, Trigonometric series, Fourier Series, Euler’s formulae, Conditions for existence of Fourier series, Even and odd functions, Half range expansions, Complex Fourier series, Applications of Fourier series, Parseval’s identity, Harmonic analysis.	12
3	LAPLACE TRANSFORM Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, Unit step function, Dirac’s delta function, Differentiation and integration of transforms, Applications to differential equations.	10

Course Outcomes:

1	Use vector calculus to analyze scalar and vector fields and compute the gradient, divergence and curl.
2	Evaluate line, surface and volume integrals.
3	Apply Green’s Theorem, Divergence Theorem and Stoke’s theorem to evaluate integrals..
4	Expand a function in terms of its Fourier series and to apply harmonic analysis to numerical data.
5	Evaluate Laplace transforms and inverse Laplace transforms of functions.
6	Apply Laplace transforms to solve ordinary differential equations arising in engineering problems.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Calculus and Analytic Geometry, G. B. Thomas and R. L. Finney, Pearson Education	2014
2	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
3	Advanced Engineering Mathematics, M.D. Greenberg, Pearson Education Asia	2010
4	Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill	2003

Course Name	:	PARTIAL DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS
Course Code	:	MAN 106
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to formulate and solve linear and nonlinear partial differential equations and apply partial differential equations to engineering problems. The students should be able to solve ordinary differential equations using series solutions, describe special functions as solutions to differential equations and expand functions in terms of eigenfunctions and to solve Sturm Liouville's problems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	PARTIAL DIFFERENTIAL EQUATIONS Formation and solution of first order partial differential equations, Linear equations of higher order with constant coefficients, Applications to Engineering problems.	17
2	SPECIAL FUNCTIONS Series solution of differential equations, Power series methods, Series solution of Legendre's differential equation Legendre's polynomial, generating functions, Recurrence relations, Frobenius method, Series solution of Bessel's differential equation, Bessel's functions, Modified Bessel's functions, generating functions, Recurrence relations, Equations reducible to Bessel's equation, Sturm Liouville's problem, Eigen function expansions.	25

Course Outcomes: By the end of the course, the students will be able to

1	Formulate and solve linear and nonlinear partial differential equations
2	Apply partial differential equations to engineering problems.
3	Solve differential equations using series solutions.
4	Describe special functions as solutions to differential equations.
5	Expand functions in terms of eigenfunctions and to solve Sturm Liouville's problems.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
2	Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill	2003
3	Elements of Partial differential equations, Sneddon, McGraw Hill	2006

Course Name	:	NUMERICAL ANALYSIS
Course Code	:	MAN 109
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to describe errors involved in computations and to estimate these errors. The students should be able to solve equations, apply numerical methods to interpolate, extrapolate, differentiate and integrate functions. They should be able to solve differential equation using numerical methods and solve systems of equations.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	ERRORS	5

	Errors in numerical calculations, Absolute, relative and percentage errors, Round off and truncation errors, Error propagation, Loss of significant digits, Errors in series approximation, Speed of convergence.	
2	SOLUTION OF EQUATIONS Bisection method, Fixed point iteration and its convergence, Acceleration of convergence using Aitken's method; Regula-Falsi, Newton-Raphson, Generalized Newton's, Chebyshev's and Halley's methods.	7
3	INTERPOLATION Lagrange Interpolation, Newton's divided difference interpolation, Finite differences, Newton's, Bessel's, Stirling's and Gauss' difference formulae.	10
4	NUMERICAL DIFFERENTIATION & INTEGRATION Differentiation using differences, Integration using Newton-cote's formulas with errors, Gaussian Quadrature.	8
5	SOLUTION OF LINEAR SYSTEM OF EQUATIONS Direct methods - Gauss elimination, Partial pivoting, Complete pivoting, Gauss-Jordan and factorization methods, Iterative methods-Gauss Siedal and Jacobi's methods.	6
6	NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS Solution of first order differential equations using Taylor's series, Euler's, Picard's and Runge-Kutta method upto 4 th order, Predictor-Corrector methods (Adam's and Milne's method),	6

Course Outcomes:

1	Describe errors involved in computations and to estimate the errors.
2	Solve algebraic and transcendental equations using Bisection method Regula-Falsi, Newton-Raphson,
3	Generalized Newton's, Chebyshev's and Halley's methods.
4	Apply numerical methods to interpolate, extrapolate differentiate and integrate functions.
5	Solve systems of equations.
6	Solve differential equation using numerical methods.(Taylor's series, Euler's, Picard's and Runge-Kutta method upto 4 th order, Predictor-Corrector methods)

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
2	Numerical Methods for Mathematics, Science and Engineering, Mathews, Prentice Hall	1992
3	An Introduction to Numerical Analysis, Atkinson, John Wiley	2012

Course Name	:	OSCILLATIONS AND OPTICS
Course Code	:	PYN101
Credits	:	4
L T P	:	3 1/2 2/2

Course Objectives:

To familiarize the students with Ultrasonics and their applications
To acquaint the students with simple harmonic motion along with damping and driving forces

To refresh the basics of interference, diffraction and polarization and familiarize the students with their applications through lectures and experiments
 To teach the students the basic concepts of LASER and to familiarize them various kinds of lasers
 To acquaint the students with fundamentals of holography

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	ULTRASONICS: Production, detection and uses of ultrasonics, reverberation, sabine's formula (no derivation)	3
2	SHM: Review of basic kinematics (displacement, velocity, acceleration, time period and phase of vibration) and dynamics (restoring force and energetics) of simple harmonic motion, differential equation of SHM, superposition of two SHM in one dimension, charge oscillations in LC circuits	4
3	DAMPED OSCILLATIONS: Concept and cause of damping, differential equation of a damped oscillator and different kinds of damping, Methods of describing damping of an oscillator - logarithmic decrement, relaxation time, quality factor, band width. Series LCR circuit as a damped oscillator.	4
4	FORCED OSCILLATIONS: States of forced oscillations, differential equation of forced oscillator – its displacement, velocity and impedance, behaviour of displacement and velocity with driver's frequency, Power, bandwidth, Quality factor and amplification of forced oscillator, resonance in forced oscillators, forced oscillations in series LCR circuit	5
5	WAVE MOTION: Wave equation and its solution, characteristic impedance of a string, reflection and transmission of waves on a string at a boundary, reflection and transmission of energy, the matching of impedances	3
6	INTERFERENCE: Division of wave front and amplitude; Fresnel's biprism, Newton's rings, Michelson interferometer and its applications for determination of λ and $d\lambda$.	4
7	DIFFRACTION: Fresnel and Fraunhofer diffraction, qualitative changes in diffraction pattern on moving from single slit to double slit, plane transmission grating, dispersive power & resolving power of a grating.	5
8	POLARIZATION: Methods of polarization, analysis of polarized light, quarter and half wave plates, double refraction.	4
9	LASERS: Elementary idea of LASER production, spontaneous emission, stimulated emission, Einstein's coefficients, Helium-Neon, Ruby and semiconductor lasers, applications of lasers.	4
10	FIBRE OPTICS: Basics of optical fibre - its numerical aperture, coherent bundle, step index and graded index fibre, material dispersion, fibre Optics sensors, applications of optical fibre in communication systems.	4
11	HOLOGRAPHY: Basic principle, theory and requirements.	2

List of Experiments:

1	To find the wavelength of sodium light using Fresnel's biprism.
2	(i) To determine the wavelength of He-Ne laser using transmission grating. (ii) To determine the slit width using the diffraction pattern.
3	To determine the wave length of sodium light by Newton's rings method.
4	To determine the wave length of sodium light using a diffraction grating.
5	To find the specific rotation of sugar solution using a Bi-quartz Polarimeter.
6	To design a hollow prism and used it find the refractive index of a given liquid

Course Outcomes:

1	Students are aware of latest developments in certain areas of Physics which have important applications for societal needs.
2	Students learn about lasers and fibre optics which have important applications for societal needs.
3	Students are expected to develop capability to tackle problems in general and in the various areas covered in the course.

Reference Books:	
Sr. No.	Name of Book/ Authors/ Publisher
1	Physics for Engineers (Prentice Hall India) - N.K. Verma
2	Physics of Vibrations and Waves (5th Edition, John Wiley & Sons) – H.J.Pain
3	Optics – Ajoy Ghatak

Course Name	:	CONDENSED MATTER PHYSICS
Course Code	:	PYN102
Credits	:	4
L T P	:	3 1/2 2/2

Course Objectives:
To teach the students the basic concepts of crystal structure and defects
To familiarize the students with the concepts of Free electron theory of metals and its applicability
To acquaint the students with the concepts of Dielectric and Magnetics materials with their applications through lectures and experiments
To impart to the students the concepts of superconductivity and nanotechnology
To teach the students the basic concepts of crystal structure and defects

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	CRYSTAL STRUCTURE: Space lattices and their symmetries, crystal structures (cubic and hexagonal cells), assignment of coordinates, directions and planes in crystals, linear, planer and space densities in crystals, close packed morphology (Hexagonal and cubic close packing), single and polycrystalline structures, interstitial spaces (trigonal, tetrahedral and octahedral voids, crystal Structure analysis, X-ray diffraction and Bragg's law, crystal defects, Point, line, surface and volume imperfections	(11)
2	THEORY OF METALS: Free electron theory, electrical properties, thermal properties, motion in magnetic field (cyclotron resonance), Zone theory. Band theory of solids, Kronig-Penney Model (qualitative), conductors, insulators and semiconductors	(6)
3	DIELECTRIC MATERIALS: Review of basic formulas, dielectric constant and polarizability, sources of polarizability, classical treatment of dipolar, ionic and electronic polarizability, piezoelectricity, ferroelectricity.	(5)
4	MAGNETIC MATERIALS: Review of basic formulas, magnetic susceptibility, classification of materials, Langevin diamagnetism, paramagnetism (only classical treatment), magnetism in metals, ferromagnetism in insulators, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis	(8)
5	SUPERCONDUCTIVITY: Zero resistance, occurrence of superconductivity, Meissner effect, critical field, thermodynamics of superconducting transitions, electrodynamics of superconductors, qualitative idea of BCS theory.	(4)
6	SEMICONDUCTORS: p-type and n-type semiconductors, statistics of electrons and holes, Hall effect (for single as well as both type of charge carriers)	(4)
7	NANOTECHNOLOGY: Introduction, Synthesis of Nanoparticles: Mechanical Method, Sputtering, Chemical Vapour Deposition, Sol-gel Technique, Applications of Nanotechnology	(4)

List of Experiments:	
1	To find the energy band gap of the given semiconductor by four probe method.
2	To study the Hall Effect of a given semiconductor.
3	To determine the dielectric constant of the given materials.

4	To study the B-H curve of the ferromagnetic materials.
5	To determine the value of e/m for electron by long solenoid (helical) method.
6	To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph.

Course Outcomes:	
1	Students learn about dielectric and magnetic materials which have important applications for societal needs.
2	Students learn about superconductivity and nanotechnology which have important applications.
3	Students are expected to develop capability to tackle problems in general and in the various areas covered in the course.

Suggested Books:	
Sr. No.	Name of Book/ Authors/ Publisher
1	Material science and Engineering – An Introduction by William D Callister, Jr, Sixth Edition, John Wiley and Sons.
2	Material science and Engineering – A First Course by V.Raghvan Fourth Edition, Eastern Economy Edition
3	Solid State Physics (New Age Publishers) – S.O. Pillai
4	Introduction to Solids (Tata McGraw Hill, Third Edition) - Leonid V Azaroff

Course Name	:	MECHANICS
Course Code	:	PYN - 105
Credits	:	4
L T P	:	3-1-0

Course Objectives:	
To acquaint about the engineering aspects of Mechanics	
To familiarize Kinematics and Kinetics of rigid body	
To inculcate the application of Mechanic concepts in engineering	
To familiarize the application of relative motion analysis in the design of energy system	

Total No. of Lectures – 36

Lecture wise breakup		Number of Lectures
1	KINEMATICS OF A PARTICLE: Introduction. Rectilinear Kinematics: General Curvilinear Motion. Curvilinear Motion: Rectangular Components, Normal and Tangential Components, Cylindrical Components. Absolute Dependent Motion Analysis of Two Particles. Relative-Motion Analysis of Two Particles Using Translating Axes. Motion of a Projectile.	5
2	KINETICS OF A PARTICLE: FORCE AND ACCELERATION: Newton's Laws of Motion. The Equation of Motion. Equation of Motion for a System of Particles. Equations of Motion: Rectangular Coordinates, Normal and Tangential Coordinates, Cylindrical Coordinates. Central-Force Motion and Space Mechanics.	4
3	KINETICS OF A PARTICLE: WORK AND ENERGY: The Work of a Force. Principle of Work and Energy. Principle of Work and Energy for a System of Particles. Power and Efficiency. Conservative Forces and Potential Energy. Conservation of Energy.	3
4	KINETICS OF A PARTICLE: IMPULSE AND MOMENTUM: Principle of Linear Impulse and Momentum. Principle of Linear Impulse and Momentum for a System of Particles. Conservation of Linear Momentum for a System of Particles. Impact. Angular Momentum. Relation Between Moment of a Force and Angular Momentum. Angular Impulse and Momentum Principles.	4
5	PLANAR KINEMATICS OF A RIGID BODY: Rigid-Body Motion. Translation. Rotation About a Fixed Axis. Absolute General Plane Motion Analysis. Relative-Motion	4

	Analysis: Velocity, Instantaneous Center of Zero Velocity, Acceleration. Relative-Motion Analysis using Rotating Axes.	
6	PLANAR KINETICS OF A RIGID BODY: FORCE AND ACCELERATION: Moment of Inertia. Planar Kinetic Equations of Motion. Equations of Motion: Translation, Rotation About a Fixed Axis, and General Plane Motion.	4
7	PLANAR KINETICS OF A RIGID BODY: WORK AND ENERGY: Kinetic Energy. The Work of a Force. The Work of a Couple. Principle of Work and Energy. Conservation of Energy.	3
8	PLANAR KINETICS OF A RIGID BODY: IMPULSE AND MOMENTUM: Linear and Angular Momentum. Principle of Impulse and Momentum. Conservation of Momentum. Eccentric Impact.	3
9	THREE-DIMENSIONAL KINEMATICS OF A RIGID BODY: Rotation About a Fixed Point. The Time Derivative of a Vector Measured from a Fixed and Translating-Rotating System. General Motion. Relative-Motion Analysis using Translating and Rotating Axes.	3
10	THREE-DIMENSIONAL KINETICS OF A RIGID BODY: Moments and Products of Inertia. Angular Momentum. Kinetic Energy. Equations of Motion. Gyroscopic Motion. Torque-Free Motion.	3

Course Outcomes:	
1	The student will be able to understand the concepts of Mechanics.
2	The students will be able to apply the concepts of Mechanics in fluid of energy.
3	The students will be able to understand various types of motion characteristic and found characteristic of rigid body.

Suggested Books:	
Sr. No.	Name of Book/ Authors/ Publisher
1	R.C. Hibbeler, Dynamics (11 th Ed) Pearson Publishers.
2	F.P. Beer et al. Dynamics (8 th Ed) Mc GrawHill Publishers.
3	Merriam and Kraige; Dynamics (5 th Ed) Wiley and Sons Publications Merriam and Kraige.
4	R.C. Hibbeler, Statics (11 th Ed) Pearson Publishers.

Course Name	:	ELECTROMAGNETIC THEORY
Course Code	:	PYN-106
Credits	:	4
L T P	:	3 1/2 2/2

Course Objectives:	
At the end of the course, the student should be able to understand the classification of the vector fields. The student should be able to apply the concepts of electrostatics and boundary value problems. The student should be able to understand concepts of electromagnetic wave propagation.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	VECTORS AND FIELDS: Cartesian coordinate System, Cylindrical and Spherical coordinate Systems, Constant coordinate surfaces, Del operator, Gradient, Divergence of a Vector and Divergence Theorem, Curl of a vector and Stoke's theorem, Gradient, Divergence, Curl and Laplacian in the three coordinate Systems, Laplacian of a scalar, Scalar & Vector Fields, Classification of Vector field. Sinusoidally time-varying fields, Complex Numbers and Phasor technique.	10
2	ELECTROSTATICS:	10

	Field intensity, Gauss's law & its applications, Maxwell's 1 st eqn. (Electrostatics), Electric Energy and potential, the line integral, Potential gradient, the dipole fields, Energy density in an electrostatic field. Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, the nature of Dielectric materials and related Boundary conditions, Capacitance, Capacitance of a two-wire line, Current analogies. Electrostatic boundary-value problems, Laplace's and Poisson's equations, Uniqueness theorem, General procedure for solving Laplace's and Poisson's equation, Resistance and capacitance, Method of images.	
3	MAGNETOSTATICS: Biot-Savart's law, Ampere's circuital law, Applications of Ampere's law, Magnetic flux and magnetic flux density-Maxwell's eqn., Maxwell's eqn. for static electromagnetic fields, Scalar and vector magnetic potentials. Magnetic dipole, Force due to Magnetic field on a differential current element, force between two differential current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Inductors and inductances, Magnetic energy, Magnetic circuits, Potential energy and force on magnetic materials.	11
4	MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVE PROPAGATION: Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, Kirchoff's Voltage law and Kirchoff's Current law from Maxwell's equations, EM waves in general, EM wave propagation in Lossy Dielectrics, Wave propagation in lossless dielectrics, Plane waves in free space, Plane waves in Good conductors, Power & Poynting Vector, Reflection of a plane wave at normal incidence, Reflection of a plane wave at oblique incidence.	11

List of Experiments:		Number of Turns
1	To design a method to draw equipotential lines with various geometries of electrodes kept at different potentials	1
2	To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph	1
3	To find the energy band gap of the given semiconductor by four probe method	1
4	To study the Hall effect of a given semiconductor	1
5	To determine the dielectric constant of the given materials	1
6	To study the B-H curve of the ferromagnetic materials	1

Course Outcomes:	
1	By the end of the course, the student will be equipped with the tools of electromagnetic theory.
2	The student will be able to solve numerical problems based on vector fields, electrostatics, magnetostatics and electromagnetic wave propagation.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Engineering Electromagnetics, William H Hyat, Jr., and John A. Buck, Tata McGraw Hill	2013 / 5 th edition
2	Elements of Engineering Electromagnetics, Matthew N.O. Sadiku, Oxford University Press	2012 / 4 th edition
3	Introduction to Electrodynamics, D.J. Griffiths, Prentice Hall	2012 / 4 th edition

Course Name	:	APPLIED CHEMISTRY
Course Code	:	CHN101
Credits	:	4
L T P	:	3 0 3

<p>Course Objectives: Upon completion of this course, students will have fundamental knowledge of the following: Concepts of water and its analysis, polymer chemistry, solid state chemistry, lubricants, coordination chemistry and substitution reactions as applied to various industries. Spectroscopic methods required for the characterization of engineering materials. Design and development of novel future engineering materials and processes. Experiments related to applications of analysis and chemical processes relevant to various Industries.</p>
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Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	WATER TREATMENT AND ITS ANALYSIS: Boiler feed water and its problems, Water Softening techniques, Domestic Water treatment, Chemical Analysis and related numerical problems	7
2	POLYMER CHEMISTRY: Classification, Mechanism and methods of polymerization, preparation, properties and uses of few engineering.	5
3	SOLID STATE CHEMISTRY: Introduction to structure and bonding-ionic solids, crystal defects and applications of defect structure (transistors, rectifiers, photovoltaic cells and computer chips).Introduction to ceramics.	6
4	LUBRICANTS/ FUEL CELL TECHNOLOGY/CORROSION: Functions mechanism, classification, properties and analysis of Lubricants and related numerical problems. Introduction to electrochemistry, types of electrodes, Reference electrodes, Ion-selective electrodes, Concentration cells, Batteries, Fuel cells/ Types of corrosion, dry and wet corrosion and their mechanisms, types of electrochemical corrosion, factors influencing corrosion, Prevention of corrosion.	6
5	ATOMIC AND MOLECULAR SPECTROSCOPY: AAS- Principle, instrumentation and applications of UV,IR and NMR spectroscopy and related problems.	10
6	COORDINATION CHEMISTRY: Crystal Field Theory, Splitting of octahedral, tetrahedral and square planer complexes, Applications of crystal field theory.	4
7	AROMATIC ELECTROPHILIC AND NUCLEOPHILIC SUBSTITUTION: Reaction mechanisms and applications.	4

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:	
1	Apply the knowledge for water treatment and its analysis for processing and its disposal which is relevant to all Industries for efficient utilization of water as an essential industrial resource.
2	Develop and design new materials based on knowledge of polymers, solid chemistry and substitution reactions
3	Hands on experience for carrying out experiments with precision for characterization and estimation of materials by wet analysis.
4	Will be able to carry out Instrument based spectroscopic analysis of new materials and interpretation of relevant data.

Reference Books:	
Sr. No.	Name of Book/ Authors/ Publisher
1	Atkin's Physical Chemistry by Peter Atkins, Julio de Paula, 7 th Edition, Oxford University Press.
2	Concise Inorganic Chemistry Vth Edition J D Lee 2003 (Chapman & Hall)
3	A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co. Pvt. Ltd.
4	Introductory Polymer Chemistry by G.S.Mishra, John Wiley & Sons, New York, 1993.
5	Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and P.L. Gaus, 3rd Ed., John Wiley & Sons.

6	Puri, Sharma and Pathania : Principles of Physical Chemistry, W.H. Freeman & Co, 2008.
7	Organic Chemistry by Joseph M.Hornback Brooke/Cole Publishing Company U.S.A.
8	D. S. Pavia, G.M. Lasmpman and G.S. Kriz : Introduction to Spectroscopy, 4 th Edition, Thomson learning, Indian Edition 208.
9	Chemistry for environmental engineering by C. N. Sawyer, P. McCarty, G. F. Parkin, Mc Graw Hill Inc, New York.

Course Name	:	PHYSICAL CHEMISTRY
Course Code	:	CHN-102
Credits	:	4
L T P	:	3 0 3

Course Objectives:
At the end of this course the students should be able to describe and implement concepts and principles of Physical Chemistry required for indepth understanding of Physical phenomena of materials in relation to applications in Engineering .

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	CHEMICAL EQUILIBRIUM : General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between K _p , K _c and K _x . Temperature dependence of equilibrium constant-Van't Hoff equation, Le Chatelier's principle.)	4
2	SOLUTIONS: Ideal and non-ideal solutions, Raoult's law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids such as Phenol- water, triethylamine- water, and Nicotine- water systems. Henry's law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.	8
3	CHEMICAL KINETICS: Rate equation of reactions of various orders, rate mechanism, kinetics of complex reactions. Concept of energy barrier and energy of activation. Theories of reaction rates, measurement of extent of reaction, zero order reactions. Rates of flow systems. Lindemann theory of unimolecular reactions.	8
4	SURFACE PHENOMENA: Adsorption of gases by solids. Types of adsorption, adsorption isotherms, Langmuir's adsorption equation, B.E.T. equation for determination of surface area of adsorbents, applications of adsorption, catalysis, kinetics of surface reactions. Introduction to micelles, emulsions and gels.	6
5	PHASE EQUILIBRIA : Phase rule and its thermodynamic derivation. One component systems-water, sulphur, Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems. Eutectics, freezing mixtures, ultra purity, zone refining.	6
6.	ELECTROCHEMISTRY: Conductance of electrolytic solutions, transference number and its determination, Kohlrausch's law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes, ionic equilibria. Ionization of water, ionization constants of weak acids and weak bases, hydrolysis, pH, common ion effect, solubility product and salt effect.	5
7.	ELECTROCHEMICAL CELLS: Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half- cell potential and its determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.	4

List of Experiments:		Number of Turns
1	Determination of Surface tension of liquids using Stalagmometer.	2
2	Distribution of Iodine between water and carbon tetrachloride.	2
3	Kinetics of the hydrolysis of methyl acetate in the presence of hydrochloric acid.	3
4	Adsorption of acetic acid on activated charcoal.	2
5	Conductometric and Potentiometric titrations and Colorimetry.	4

Course Outcomes: By the end of this course, the student will be able to-	
1	Understand the phenomenon of chemical equilibrium, phase equilibria and effect of change of process parameters such as T, P, C etc both quantitatively and qualitatively.
2	Understand physical properties of solutions like change of free energy, entropy of mixing as applies to heat and mass transfer in chemical processes.
3	Analyse the kinetics of chemical processes that are useful in the design of reactors and optimisation of material processing and its implementation.
4	Apply concepts of various surface phenomena for material coatings, separate technology and in catalytic processes.
5	Design the sensors based on the concepts of electrochemistry.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Principles of Physical Chemistry by Maron, Samuel H. Prutton, ; Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.	2002
2	Textbook of Physical Chemistry by Carl F. Glasstone, Samuel ; MacMillan and Co. Ltd. London	2010
3	Principles of Physical Chemistry by B.R Puri., L.R Sharma, and Pathania, S Madan,; S. Nagin &Co Jalandhar.	2013
4	Chemical Kinetics by Laidler , J Keith ;Tata McGraw-Hill Co. Ltd., New Delhi.	2002
5	A Text Book of Physical Chemistry by P.W Atkins; Oxford University Press.	2009
6	Findlay's Practical Physical Chemistry by B.P Lavitt. ; Longman Group Ltd.	1973

Course Name	:	INORGANIC CHEMISTRY
Course Code	:	CHN-103
Credits	:	4
L T P	:	3 0 3

Course Objectives: Upon completion of this course, students will have fundamental knowledge of the following:
<p>Concepts of structure and chemical bonding essential for understanding of molecular structure.</p> <p>Solid state chemistry for application in electronics, ceramics and other advanced materials.</p> <p>Magnetic behaviour and catalytic properties of co-ordination and organometallic compounds used in various industries.</p> <p>Interaction and role of metals in biological systems essential for bio-engineering applications.</p>

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	QUANTUM THEORY AND ATOMIC STRUCTURE: Introduction to wave mechanics, the Schrodinger equation, the Schrodinger equation as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals.	4

2	CHEMICAL BONDING: Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.	7
3	THE SOLID STATE: A recapitulation of close packing of spheres, structures of NaCl, CsCl, ZnS, CaF ₂ , crystal defects and applications of defect structures (transistors, rectifiers, photovoltaic cells and computer chips).	4
4	COORDINATION COMPOUNDS: Part 1: Werner's theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series).	6
5	COORDINATION COMPOUNDS: Part 2: Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - SN ¹ , SN ²). Magnetic behaviour of complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism and measurement of magnetic susceptibility of complexes by Gouy's method.	6
6	ORGANOMETALLIC COMPOUNDS: Nomenclature, types of ligands and bonding in organometallic compounds, use of organometallics in industry.	5
7	INORGANIC POLYMERS: TYPES of inorganic polymers, polyphosphazenes, polysiloxanes – their structures and properties.	5
8	ROLE OF METALS IN BIOLOGICAL SYSTEMS: Bio-inorganic Chemistry of Iron – Heme proteins & Non-Heme iron proteins; bioinorganic chemistry of cobalt-vitamin B12 and metalloenzymes.	5

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:

1	Apply the knowledge of quantum theory, chemical bonding and solid state, to know the structure and bonding required for the development of new materials.
2	Design new inorganic materials with desired physical and chemical properties.
3	Carry out experiments with precision related to synthesis and characterization of new industrially important inorganic materials.

Reference Books:

Sr. No.	Name of Book/ Authors/ Publisher
1	Sharpe, A. G. : Inorganic Chemistry, 3rd Edition, Longman Publishers ELBS, 1992.
2	Lee, J. D. : Concise: Inorganic Chemistry, 5th Edition, Chapman and Hall Publishers, 1996.
3	Cotton, F. A. & Wilkinson, G. : Advanced Inorganic Chemistry, 3rd Edition, Wiley Eastern Ltd., 1982.
4	Cotton, F. A. & Wilkinson, G. : Basic Inorganic Chemistry, Wiley Eastern Ltd., 1987. 12
5	Mark, J., West, R. & Allcock, H. : Inorganic Polymer, Prentice Hall, New Jersey Publishers, 1982.

Course Name	:	PHYSICAL CHEMISTRY
Course Code	:	CHN-104
Credits	:	4
L T P	:	3 0 3

Course Objectives:

Concepts of chemical equilibria, solutions, chemical kinetics and electrochemistry to the physical phenomena occurring in various chemical processes.
Surfaces modification of important industrial materials used in adsorption and separating technology.
Phase equilibria for understanding the physical behaviour of various materials such as alloys and other biphasic and triphasic systems.
Experiments related to the theoretical studies of different physical phenomena relevant to various industries.

Total No. of Lectures – 42

Lecture wise breakup	Number of
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		Lectures
1	CHEMICAL EQUILIBRIUM: thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between K_p , K_c and K_x . Temperature dependence of equilibrium constant- Le Chatelier's principle.	5
2	SOLUTIONS: Raoult's law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids Henry's law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.	8
3	CHEMICAL KINETICS: Rate equation of various orders, rate mechanism, kinetics of complex reactions. Theories of reaction rates, measurement of extent of reaction, Rates of flow systems. Lindemann theory of unimolecular reactions.	8
4	SURFACE PHENOMENA: Adsorption of gases by solids., adsorption isotherms., Langmuir's adsorption equation, B.E.T. equation for determination of surface area of adsorbents, applications of adsorption, catalysis, kinetics of surface reactions. Introduction to micelles, emulsions and gels.	6
5	PHASE EQUILIBRIA : Phase rule and its thermodynamic derivation. One component systems-water, sulphur, Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems. Eutectics, freezing mixtures, ultra purity, zone refining.	6
6	ELECTROCHEMISTRY: transference number and its determination, Kohlrausch's law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes, ionic equilibria. Ionization of water, ionization constants of weak acids and weak bases, common ion effect, solubility product and salt effect.	5
7	ELECTROCHEMICAL CELLS: Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half-cell potential and its determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.	4

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:

1	Understand the relevance of the physical phenomena occurring in various materials and processes.
2	Modify the composition of various materials required for new technological applications.
3	Hands on experience for carry out experiments with precision related to chemical equilibria, surface phenomena and reaction kinetics required for designing various processes in Industry.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher
1	Maron, Samuel H. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
2	Carl F. Glasstone, Samuel Textbook of Physical Chemistry, MacMillan and Co. Ltd. London.
3	Puri, B.R., Sharma, L.R. and Pathania, Madan, S. Principles of physical chemistry, S.Nagin & co Jalandhar.
4	Laidler, Keith J. Chemical Kinetics, Tata McGraw-Hill Co. Ltd., New Delhi.
5	Atkins, P.W. A Text Book of Physical Chemistry, Oxford University Press.

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSSMEC)

Course Name	:	ETHICS AND SELF AWARENESS
Course Code	:	HSS 101
Credits	:	2
L T P	:	2-0-0

Course Objectives:

To provide basic knowledge about ethics, values, norms and standards and their importance in real life.
To improve the personality of students by their self-assessment

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO ETHICS Concept of Ethics – Nature, Scope, Sources, Types, Functions and Factors influencing Ethics, Approaches to Ethics – Psychological, Philosophical and Social, Broader Ethical Issues in Society	6
2	VALUES, NORMS, STANDARDS AND MORALITY Concept and Role, Relation with Ethics, Psycho-Social Theories of Moral Development – Kohlberg and Carol Gilligan	4
3	ETHICS AND BUSINESS Concept of Business Ethics – Nature, Objectives and Factors influencing Business Ethics, 3 C's of Business Ethics, Ethics in Business Activities, Ethical Dilemmas in Business, Managing Ethics	5
4	SELF-AWARENESS Concept of Self Awareness – Need, Elements, Self Assessment – SWOT Analysis, Self Concepts – Self-Knowledge, Assertiveness and Self-Confidence, Self-Esteem	4
5	SELF-DEVELOPMENT Concept of Self-Development, Social Intelligence, Emotional Intelligence, Managing Time and Stress, Positive Human Qualities (Self-Efficacy, Empathy, Gratitude, Compassion, Forgiveness and Motivation), Personality Development Models – Johari Window, Transactional Analysis, Myers Briggs Type Indicator, Self-Awareness and Self-Development Exercises	9

Course Outcomes:

1	Helps to distinguish between right and wrong in both personal and professional life
2	Students learn about their strengths, weaknesses, opportunities & threats and work enthusiastically to transform weaknesses into strengths and threats into opportunities

Reference Books:

1	Murthy, C.S.V., “Business Ethics – Text and Cases”, Himalaya Publishing House
2	Hartman, Laura P. and Chatterjee, Abha, “Business Ethics”, Tata McGraw Hill
3	Rao, A.B., “Business Ethics and Professional Values”, Excel Books
4	Velasquez, Manuel G., “Business Ethics – Concepts and Cases”, Prentice Hall
5	Corey, G., Schneider, Corey M., and Callanan, P., “Issues and Ethics in the Helping Professions”, Brooks/Cole
6	Hall, Calvin S., Lindzey, Dardner and Cambell, John B., “Theories of Personality”, Hamilton Printing Company
7	Leary, M.R., “The Curse of Self: Self-awareness, Egotism and the Quality of Human Life”, Oxford University Press

Course Name	:	COMMUNICATION SKILLS (BASIC)
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Course Code	:	HSS 102
Credits	:	2
L T P	:	1-0-2

Course Objectives:

The main aim of the course is to build competence in English grammar and vocabulary and to enhance effective communication by developing Reading, Writing, Listening and Speaking skills of students.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	FUNDAMENTALS OF COMMUNICATION SKILLS Scope and Significance of Communication Skills, Listening, Speaking, Reading and Writing	3
2	WRITING SKILLS Basics of Grammar – Placing of Subject and Verb, Parts of Speech, Uses of Tenses, Active-Passive, Narration	3
3	VOCABULARY BUILDING AND WRITING Word Formation & Synonyms, Antonyms, Words Often Confused, One-Word Substitutes, Idioms and Phrasal Verbs, Abbreviations of Scientific and Technical Words	3
4	SPEAKING SKILLS Introduction to Phonetic Sounds & Articulation, Word Accent, Rhythm and Intonation	3
5	READING AND COMPREHENSION Two comprehensive prose passages	2

List of Experiments:		Number of Turns
1	Introducing Oneself, Exercise on Parts of Speech & Exercise on Tense	2
2	Exercise on Agreement, Narration, Active Passive Voice & Dialogue Conversation	2
3	Exercise on Writing Skills and Listening Comprehension (Audio CD)	2
4	Practice of Phonemes, Word Accent, Intonation, JAM Session	2
5	Individual Presentation, Extempore and Picture Interpretation	2
6	Vocabulary Building Exercises (One Word Substitute, Synonyms, Antonyms, Words Often Confused etc.) & Group Discussion	2
7	Reading Comprehension & Organizational Correspondence and Debate	2

Course Outcomes:

1	The students will be able to perform better in their academic and professional life.
2	The student will gain self-confidence with improved command over English.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“The Essence of Effective Communication”, Ludlow R. and Panton F., Pubs: Prentice Hall.	1992
2	“A University Grammar of English”, Quirk R. and Sidney G., 3 rd Edition, Pubs: Pearson Education.	2008
3	“High School English Grammar”, Wren and Martin, Pubs: S. Chand & Company Ltd.	2007
4	“Essentials of Business Communication”, Guffrey M.E., 8 th Edition, Pubs: South-Western College Publishing.	2009
5	“Technical Communication: Principles and Practice”, Raman M. and Sharma S., 2 nd Edition, Pubs: Oxford University Press.	2012
6	“Effective Business Communication”, Rodrigues M.V., Pubs: Concept Publishing Company, Delhi.	2003
7	“English Vocabulary in Use”, McCarthy M. and Felicity O’ Dell, 2 nd Edition, Pubs:	2010

	Cambridge University Press.	
8	“The Pronunciation of English”, Jones D., Pubs: Universal Book Stall.	1992

Course Name	:	COMMUNICATION SKILLS (ADVANCED)
Course Code	:	HSS 103
Credits	:	2
L T P	:	1-0-2

Course Objectives:
The main aim of the course is to enhance communication skills of students for better performance in professional life and to improve their overall personality with the use of advanced techniques in speaking and writing and also to train them in using both verbal and non-verbal communication effectively.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO COMMUNICATION PROCESS Scope, Significance, Types and Levels, Technical Communication, Tools of Effective Communication	3
2	SPEAKING SKILLS AND PERSONALITY DEVELOPMENT Interpersonal Communication, Oral Presentation, Body Language and Voice Modulation (Para linguistics and Non- Verbal), Negotiation and Persuasion, Group Discussion, Interview Techniques (Telephonic and Video Conferencing)	6
3	ADVANCED Technical Writing Job Application, CV Writing, Business Letters, Memos, Minutes, Notices, Report Writing & Structure, E-mail Etiquette, Blog Writing	4
4	COMMUNICATION AND MEDIA Social and Political Context of Communication, Recent Developments in Media	1

List of Experiments:		Number of Turns
1	ORGANIZATIONAL COMMUNICATION Verbal and Non-Verbal Communication at different levels of organization, Role Play, Case Studies	2
2	SPEAKING TECHNIQUES Mock Interviews, Participation in Group Discussions, Making and Presenting Power Point	4
3	STANDARD ENGLISH & PRACTICE SESSION Intonation and Pronunciation, Exposure to Standard English, Sounds, Stress and Rhythm, Comprehension on British and American English	4
4	PRACTICE ON TECHNICAL WRITING Writing Letters, Memos, Minutes, CV, Job Applications, Reports and e-mails	4

Course Outcomes:	
1	The students will gain proficiency in English language for both professional and personal life.
2	The students will learn technical aspects of communication for better performance in extra-curricular activities, recruitment process and prospective jobs.
3	The students will be able to refine their personality through a grip over advanced techniques of language.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint

1	“Effective Technical Communication”, Rizvi M.A., 5 th Reprint, Pubs: McGraw Hill Education (India).	2007
2	“Technical Communication: Principles and Practice”, Raman M. and Sharma, S., 2 nd Edition, Pubs: Oxford University Press.	2012
3	“Business Communication Today”, Bovee C.L. and Thill J.V., 9 th Edition, Pubs: Pearson Education Asia, New Delhi.	2009
4	“Business Correspondence and Report Writing”, Sharma R.C. and Mohan K., Pubs: McGraw Hill	1994
5	“Communication for Professional Engineers”, Scott B., 2 nd Edition, Pubs: Thomas Teleford Ltd.	1997
6	“Handbook for Technical Writing”, McMurrey D.A. and Buckley J., Pubs: Cengage Learning.	2012
7	“Student Activities for taking charge of your Career Direction and Job Search”, Lock R., 3 rd Edition, Pubs: Cole Publishing	1996
8	“The Definitive Book of Body Language”, Pease A. and Pease B., Pubs: Manjul Publishing House Pvt. Ltd.	2005

Course Name	:	ECONOMICS
Course Code	:	HSS 201
Credits	:	3
L T P	:	2-1-0

Course Objectives:
The main aim of this course is to make students understand how society manages its scarce resources for achieving maximum satisfaction and to make them learn about economic aspects related to a consumer, firm, market and economy.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO ECONOMICS Nature of Economics, Economic Thoughts, Economic Activities, Relationship of Economics with other Social Sciences and Engineering	3
2	THEORY OF CONSUMER BEHAVIOUR Demand: Types, Law of Demand, Demand Supply Curve, Determinants of Demand and Change in Demand (Movement of Demand and Shift of Demand) with Case Studies Elasticity of Demand: Nature, Degrees, Types, Factors Affecting Elasticity of Demand and its Application in present scenario Laws of Consumption: Concept and Applicability of Law of Diminishing Marginal Utility and Law of Equi-Marginal Utility	9
3	THEORY OF PRODUCTION AND COST Cost: Concept and Types Production: Concept, Scale of Production, Law of Variable Proportion Returns to Factor and Returns to Scale: Causes and Implications Economies and Diseconomies of Scale: Concept and Types Relevance of Production and Cost Concept in present context	5
4	THEORY OF MARKET Market: Concept and Types (Perfect Competition, Monopoly and Monopolistic Competition), Nature and Relevance of different Markets in present scenario – Case Study	5
5	BASIC CONCEPTS OF MACRO ECONOMICS National Income: Concept and Measurement Methods, Determination of Equilibrium of Income	6

	Inflation: Concept, Causes and Effect of Inflation, Measures to Control Inflation, Case Study on Impact of Inflation	
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Course Outcomes:

1	The students are expected to apply engineering knowledge to maximize profit, satisfaction and welfare.
2	The students are able to identify the forces that affect the economy.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Modern Economics”, Ahuja H. L., Pubs: Sultan Chand and Co. Ltd, New Delhi.	2012
2	“Economics For Engineers”, Gupta M. L. and Gupta S.P., Pubs: ESS PEE Publications.	
3	“Business Economics”, Ahuja H. L., Pubs: Sultan Chand and Co. Ltd, New Delhi.	2010
4	“Macro Economic Theory”, Jhingan M.L., Pubs: Konark Publisher Pvt. Ltd., New Delhi.	1986
5	“Principles of Microeconomics”, Stiglitz J.E. and Walsh C.E., 4 th Edition, Pubs: W.W. Norton & Company.	2006
6	“Principles of Macroeconomics”, Stiglitz J.E. and Walsh C.E., 4 th Edition, Pubs: W.W. Norton & Company.	2006
7	“Principles of Economics”, Mankiw N.G., 7 th Edition, Pubs: Cengage Learning	2014
8	“Economics”, Samuelson P.A. and Nordhaus W.D., 18 th Edition, Pubs: McGraw Hill.	2004

Course Name	:	PSYCHOLOGY
Course Code	:	HSS 202
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of the course is to provide knowledge and understanding about important concepts in Psychology which will help the students in learning the applications of principles of psychology in personal and professional life.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO PSYCHOLOGY Concept, Nature and Scope Methods of Studying Human Behaviour – Introspection Method, Observation Method, Experimental Method, Case History Method, Survey Method, Psychological Test Use Relevance of these Methods in present context	4
2	INTELLIGENCE Concept and Determinants of Intelligence Theories of Intelligence and its Application: Spearman, Thurston, Guilford.	4
3	PERSONALITY Personality: Concept, Determinants of Personality, Trait Paradigm (Eysenck), Psychodynamic Paradigm (Freud), Measurement of Personality – Self Report Measures (EPQ), Projective Measures (TAT), Hypothetical Measurement of Personality	4
4	MENTAL HEALTH AND STRESS Mental Health: Concept and Factors Affecting Mental Health Stress: Nature, Rections to Stress, Outcomes of Stress, Stress Management Case Study	4

5	LEARNING AND MEMORY Learning: Concept, Reinforcement Principle and Learning, Managerial Implications Memory: Concept, Long Term Memory, Short Term Memory, Episodic Memory, Methods to Improve Memory	3
6	MOTIVATION Nature and Types of Motivation: Extrinsic and Intrinsic Theories of Motivation and its Application: Humanistic and Need Theories Factors Affecting Motivation	3
7	GROUP BEHAVIOUR AND DYNAMICS Concept and Importance, Types of Groups, Group Development, Group Performance Factors, Conflict: Nature, Conflict Resolution, Case Study	4
8	LEADERSHIP Leadership: Nature and Importance, Leadership Styles: Authoritarian, Democratic, Paternalistic, Laissez faire, Transactional, Transformational, Case Study	2

Course Outcomes:	
1	The students will learn the causes and dynamics of human behavior.
2	The students will be able to apply psychological principles to enhance their personal and professional life.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Psychology", Ciccarelli S.K. and Meyer G.E., Pubs: Pearson India.	2007
2	"Introduction to Psychology", Morgan C.T., Weiss J.R., King R.A. and Schopler J., 7 th Edition, Pubs: McGraw-Hill Education.	2004
3	"An Introduction to Psychology", Mangal S.K., 1 st Edition, Pubs: Sterling Publishers Pvt. Ltd., New Delhi.	2009
4	"Fundamentals of Social Psychology", Baron R.A., Branscombe N.R., Byrne D. and Bhardwaj G., 1 st Edition, Pubs: Pearson India.	2011
5	"Organizational Behaviour", Parikh M. and Gupta R., Pubs: McGraw Hill Education.	2010
6	"Organizational Behavior", Robbins S.P., Pubs: Prentice Hall of India.	2003

Course Name	:	SOCIOLOGY
Course Code	:	HSS 203
Credits	:	3
L T P	:	2-1-0

Course Objectives:	
The main aim of the course is to make the students understand the role of theory in social sciences and to explain them how social problems interact and react with the larger society. This course also intends to make them learn whether the problem is evaluated on the macro or micro perspective and their cause and effect patterns.	

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO SOCIOLOGY Sociology as a Science, Impact of Industrial and French Revolution on the Emergence of Sociology, Contribution of Karl Marx, Emile Durkheim, Max Weber, Alwin Toeffler to Sociology and its Application in present scenario, Relevance of Sociology for Engineering	5
2	BASIC CONCEPTS Society, Association, Institution, Culture Relativism, Social Structure, Social System,	2

	Socialization, Competition, Conflict, Accommodation, Social Mobility	
3	SOCIETY AND ECONOMY Evolution of Society: Primitive, Agrarian, Industrial and Post-Industrial, Economic Systems of Simple and Complex Societies, Sociological Dimensions of Economic Life, Market (free) Economy and Controlled (planned) Economy	4
4	INDUSTRIAL SOCIOLOGY Nature and Scope of Industrial Sociology, Pre-Conditions and Consequences of Industrialization, Impact of Automation and Industrialization on Society with Case Study	3
5	SCIENCE AND TECHNOLOGY Ethos of Science and Social Responsibility of Science	2
6	SOCIAL CHANGE Theories of Change and its Application to Sociology, Factors of Change, Directed Social Change, Social Policy and Social Development, Social Cost Benefit Analysis, Role of Engineers in Development	4
7	INDIAN SOCIETY Traditional Hindu Social Organization, Caste System, Agrarian Society in India, Social Consequences of Land Reforms and Green Revolution, Working of the Democratic Political System in a Traditional Society, Problem of Education in India, Gender Discrimination, Economic Reforms: Liberalization, Privatization and Globalization, Strategies for Development in India, Case Studies	6
8	SOCIAL PROBLEMS Concept of AIDS, Alcoholism, Drug Addiction, Corruption with Case Study	2

Course Outcomes:

1	The students will be able to identify the function and application of sociology theory in social sciences.
2	The students will be able to understand how social class affects individual life chances.
3	The students will learn about social structure and how it shapes and influences social interactions.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Sociology: Themes and Perspective”, Haralambos M. and Holborn M., Pubs: Collins Educational Publications.	2008
2	“Sociology of Indian Society”, Rao C.N.S., 2 nd Edition, Pubs: Sultan Chand and Co., New Delhi.	2004
3	“Introduction to Sociology”, Bhushan V. and Sachdeva D.R., Pubs: Kitab Mahal Publications.	2002
4	“An Introduction to Sociology”, Dassgupta S. and Saha P., Pubs: Dorling Kindersley (India) Pvt. Ltd.	2012
5	“Social Change in Modern India”, Srinivas M.N., 1 st Edition, Pubs: Orient Longman.	2010
6	“Sociology and Modern Social Problems”, Ellwood C.A., Pubs: Bastian Books.	2008
7	“Industrial Sociology”, Singh N., 1 st Edition, Pubs: McGraw Hill Education (India).	2012
8	“Society in India: Concepts, Theories and Recent Trends”, Ahuja R., 1 st Edition, Pubs: Rawat Publications.	2011

Course Name	:	FRENCH
Course Code	:	HSS 204
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of this course is to introduce students with basics of a foreign language and make them learn how to communicate in a new language.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	Introductions: introduce yourself or someone else	2
2	Greetings	2
3	Alphabet / numbers	3
4	Communication in a class	3
5	Asking and answering basic questions: name – age – nationality – profession – family, friends, acquaintances	3
6	Giving the date / day / season / time / frequency of an event	2
7	Locating a place / describing a city or a locality / giving information about one's region, city or country	4
8	Expressing quantities	2
9	Expressing one's preferences / talk about one's leisure time activities	3
10	Describing a person / talking about his/her nature	4

Course Outcomes:

1	The students will be able to express themselves in the foreign language.
2	The students will be able to make use of this language in their professional life in the globalized world.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Learn French Through English in 30 Days”, Chopra B., 1 st Edition, Pubs: Diamond Books.	2009
2	“Complete French”, Graham G., Pubs: Hodder & Stoughton.	2012
3	“French Made Easy”, Verma R., 1 st Edition, Pubs: Goodwill Publishing House, New Delhi.	2012
4	“Learn French for Beginners”, Schell R., Pubs: Maanu Graphics.	
5	“French Made Easy”, Khan F., Pubs: Lotus Press.	2010
6	“French Course Grammar”, Bertenshaw T.H., 1 st Edition, Pubs: Orient Blackswan.	1998

Course Name	:	PRINCIPLES OF MANAGEMENT
Course Code	:	HSM 401
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of this course is to make students understand the management process and principles along with its application in practical life and to help them manage different jobs and situations with the help of management functions.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO MANAGEMENT Nature of Management: Art or Science, Principles and Functions of Management	3
2	EVOLUTION OF MANAGEMENT THOUGHT Classical Theories: Bureaucratic, Scientific and Administrative Approach	6

	Neo-Classical Theories: Human Relations and Human Behaviour Approach Modern Theories of Management Relevance of Management Thought in present scenario – Management Cases	
3	PLANNING Nature of Planning, Planning Process, Application of Planning Process in a Hypothetical Situation, Types of Planning, Types of Plans, Management by Objective (MBO)	4
4	ORGANIZING Concept of Organization, Departmentation, Forms of Organization Structure Analysis of Organization Structure – Case Studies Hypothetical Formation of an Organization	4
5	STAFFING Human Resource Planning: HRP Process, Job Analysis: Job Description, Job Specifications and Used of Job Analysis Recruitment: Sources and Methods Selection: Selection Process, Role Playing and Case Study on Selection Tests and Interviews Training and Development: Techniques, Performance Appraisal: Methods Case Study on Staffing Practices	6
6	DIRECTING Concept, Leadership: Importance and Styles, Motivation: Theories and their relevance in present scenario, Communication: Process, Types and Barriers of Communication Management Game on Leadership, Motivation and Communication	3
7	CONTROLLING Nature and Process of Controlling, Requirements for Effective Controlling	2

Course Outcomes:

1	The students will be able to apply management concepts and principles in daily life and thus, will be able to manage things efficiently and effectively.
2	The students will learn how to get work done easily by using management knowledge and functions.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Principles and Practices of Management”, Rao V.S.P. and Narayana P.S., Pubs: Konark Publishers.	1987
2	“Principles & Practice of Management”, Prasad L.M., 8 th Edition, Pubs: Sultan Chand & Sons.	2012
3	“Essentials of Management: International and Leadership Perspective”, Wehrich H. and Koontz H., 9 th Edition, Pubs: McGraw Hill.	2012
4	“The New Era of Management”, Daft R.L., 11 th Edition, Pubs: Cengage Learning.	2014
5	“Management: Text and Cases”, Rao V.S.P. and Krishna V.H., Pubs: Excel Books.	2008
6	“Fundamentals of Management: Essential Concepts and Applications”, Robbins S.P, DeCenzo D.A., Bhattacharya S. and Agarwal M.N., 6 th Edition, Pubs: Pearson India.	2009

Course Name	:	BUSINESS ENVIRONMENT AND BUSINESS LAWS
Course Code	:	HSM 402
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of this course is to make students understand different types of environment influencing business decisions and to provide knowledge about different laws that needs to be followed for initiating and managing business.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO BUSINESS Scope and Characteristics of Business, Classification of Business Activities Forms of Ownership of Business: Sole Proprietorship, Partnership and Company	5
2	BUSINESS ENVIRONMENT Internal Environment: Concept and Elements (Value System, Vision Mission Objectives, Management Structure, Human Resources, Company Image etc.) SWOT Analysis: Concept and Case Study External Environment: Micro Environment (Suppliers, Customers, Competitors, Market Intermediaries etc.) and Macro Environment – PESTEL Analysis (Political, Economic, Social, Technological, Ecological and Legal), Case Study on Impact of Environment on Business	7
3	GLOBALIZATION Concept, Pros and Cons of Globalization, Impact of Global Environment on Business Globalization of Company – Case Study	4
4	CORPORATE SOCIAL RESPONSIBILITY Concept, Social Responsibility towards different stakeholders, Rationale for CSR CSR – Case Studies	2
5	CORPORATE GOVERNANCE Concept, Elements and Essentials of Good Governance	3
6	CONTRACT LAW Concept, Types and Essentials Elements of Contract	3
7	PARTNERSHIP LAW Nature of Partnership, Provisions of Partnership Act, Issues Related to Partnership Firm, Hypothetical Formation of a Partnership Firm	2
8	COMPANY LAW Nature of Company, Provisions of Company Act, Issues Related to Incorporation of Company, Hypothetical Formation of a Company	2

Course Outcomes:

1	The students will be able to analyze the impact of environment on business and formulate appropriate business strategies to compete in the competitive world.
2	The students will learn how companies follow corporate governance and social responsibility practices along with fulfilling economic objectives.
3	The students will gain knowledge about application and implementation of various business laws in practice.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Business Environment: Text and Cases”, Cherunilam F., 22 nd Edition, Pubs: Himalaya Publications.	2013
2	“Legal Aspects of Business”, Pathak A., 5 th Edition, Pubs: McGraw Hill Education.	2013
3	“Essential of Business Environment: Text, Cases and Exercises”, Aswathappa K., 11 th Edition, Pubs: Himalaya Publication.	2011
4	“Business Law Including Company Law”, Gulshan S.S. and Kapoor G.K., 15 th Edition, Pubs: New Age International (p) Ltd.	2011

5	“Business Law and Corporate Laws”, Tulsian P.C., 1 st Edition, Pubs: Sultan Chand Publishing.	2011
6	“Fundamentals of Business Organization & Management”, Bhushan Y.K., 19 th Edition, Pubs: Sultan Chand & Sons.	2013
7	“Corporate Governance: Principles, Policies and Practices”, Fernando A.C., 2 nd Edition, Pubs: Pearson India.	2011

Course Name	:	ENTREPRENEURSHIP AND PROJECT MANAGEMENT
Course Code	:	HSM 403
Credits	:	3
L T P	:	2-1-0

Course Objectives:
The main aim of this course is to make prospective engineers familiar with the concept of entrepreneurship and MSMEs and to provide knowledge about different aspects to be considered while formulating the business plan for a new entrepreneurial venture. This course also intends to create awareness among students about financial and marketing functions that is required for a new venture.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO ENTREPRENEURSHIP Concept of Entrepreneurship, Characteristics and Functions of Entrepreneur Forms of Ownership of Business, Factors Affecting Entrepreneurship Case Studies of Entrepreneurs	6
2	WOMEN ENTREPRENEURSHIP Nature of Women Entrepreneurship, Problems of Women Entrepreneurs, Institutional Initiatives for Promotion of Women Entrepreneurs	2
3	MICRO, SMALL AND MEDIUM ENTERPRISES (MSMES) Concept of MSMEs, Schemes of MSMEs Functions of Entrepreneurial Development Programmes (EDPs)	2
4	PROJECT IDENTIFICATION Idea Generation, Project Life Cycle, Concept of SWOT Analysis SWOT Analysis of Selected Project	2
5	PROJECT PLANNING AND FORMULATION Elements of Project Formulation: Product, Technical (Location, Scale, Technology, Production Process, Layout, Manpower, Resources etc.), Market, Finance and Economic Aspects Feasibility Analysis: Financial Viability and Profitability, and Socio-Economic Desirability	7
6	PROJECT REPORT Formulation of Business Plan and Project Report, Hypothetical Example of a Real-Life Project	2
7	FINANCE AND MARKETING FUNCTION Concept of Finance, Finance Related Terminologies, Sources of Finance, Cost Estimations Marketing Mix: Product, Place, Price, Promotion, People, Process and Physical Evidence Marketing Segmentation Targeting and Positioning	5
8	DISCUSSIONS ON ADDITIONAL READING (any one of the following in the semester) - The New Age Entrepreneurs - The \$100 Startup: Fire your Boss, Do what you Love and Work Better to Live More - A Guide to Entrepreneurship - Dhandha: How Gujaratis Do Business - Rokda: How Baniyas Do Business	2

	- Take Me Home - Business Families of Ludhiana	
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Course Outcomes:	
1	The students will be able to apply engineering knowledge effectively in the field of entrepreneurship development.
2	The students can make effective use of entrepreneurial knowledge to start and manage their venture.
3	The students will learn to check the feasibility of a new project to maintain its long run sustainability.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Dynamics of Entrepreneurial Development & Management”, Desai V., 5 th Edition, Pubs: Himalaya Publishing House.	
2	“Projects: Planning, Analysis, Selection, Financing, Implementation and Review”, Chandra P., 8 th Edition, Pubs: McGraw-Hill Education (India).	2014
3	“Entrepreneur’s Toolkit”, Harvard Business School, Pubs: Harvard University Press.	2004
4	“Entrepreneurship”, Hisrich R.D., Peters M.P. and Shepherd D.A., Pubs: McGraw Hill Education.	2006
5	“Essentials of Project Management”, Ramakrishna K, Pubs: PHI Learning.	
6	“Entrepreneurship”, Roy R., 2 nd Edition, Pubs: Oxford University Press	2011
7	“Entrepreneurship Development in India”, Gupta C.B. and Srinivasan N.P., Pubs: Sultan Chand and Sons.	2013

Course Name	:	FINANCIAL MANAGEMENT
Course Code	:	HSM 404
Credits	:	3
L T P	:	2-1-0

Course Objectives:	
The main aim of this course is to make students learn different financial decisions i.e. investing, financing and dividend, required to be taken by a company and provide knowledge about the functioning of the financial system (financial markets, financial institutions, financial services and financial instruments) of the country.	

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO FINANCIAL MANAGEMENT Concept of Finance, Terminology Related to Finance, Financial Decisions, Factors Affecting Financial Decisions, Risk-Return Trade-Off	3
2	FINANCIAL SYSTEM Concept and Role of Financial System in Indian Economy	2
3	FINANCIAL MARKETS AND INSTRUMENTS Concept and Relevance of Money Market and Capital Market Money Market Instruments: Call Money, Treasury Bills, Commercial Papers, Certificate of Deposits Capital Market Instruments: Equity Shares, Preference Shares and Debentures Hypothetical Trading in Financial Markets	5
4	FINANCIAL SERVICES Nature and Functions of Financial Services: Merchant Banking, Mutual Funds, Factoring, Forfaiting, Credit Rating	6

	Case Study on Financial Services	
5	FINANCIAL INSTITUTIONS Nature and Functions of Financial Institutions: Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Discount and Finance House of India (DFHI)	2
6	LONG TERM INVESTMENT DECISIONS Capital Budgeting: Concept, Importance, Factors Techniques/Methods with Numerical Applications (Pay Back Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return and Profitability Index), Case Study	3
7	SHORT TERM INVESTMENT DECISIONS Working Capital: Nature, Type and Factors Affecting the Requirement of Working Capital, Case Study	2
8	FINANCING DECISIONS Capital Structure: Essentials and Approaches of Capital Structure Sources of Finance (long-term and short-term), Financial Leverage: Concept and Numerical Application, Case Study	3
9	DIVIDEND DECISIONS Types of Dividend, Dividend Policy: Nature and Factors Affecting Dividend Policy, Case Study	2

Course Outcomes:	
1	The students will learn to make best combination of financial decisions by considering risk and return trade-off.
2	The students will identify how business can gain maximum through the financial system.
3	The students will understand how to manage funds effectively so as to maximize returns.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Financial Management”, Shah P., 2 nd Edition, Pubs: Dreamtech Press	2009
2	“Financial Markets and Services”, Gordon E. and Natarajan K., 3 rd Edition, Pubs: Himalaya Publishing House.	2006
3	“Financial Management: Theory and Practice”, Chandra P., 8 th Edition, Pubs: McGraw Hill Education (India).	2012
4	“Financial Management”, Pandey I.M., 10 th Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2010
5	“Cases in Financial Management”, Pandey I.M. and Bhat R., 3 rd Edition, Pubs: McGraw Hill Education (India).	2012
6	“Financial Institutions and Markets: Structure, Growth and Innovations”, Bhole L.M. and Mahakud J., 5 th Edition, Pubs: McGraw Hill Education (India).	2009
7	“The Indian Financial System: Markets, Institutions and Services”, Pathak B.V., 3 rd Edition, Pubs: Pearson India.	2010
8	“Financial Management and Policy”, Horne J.C.V. and Dhamija S., 12 th Edition, Pubs: Pearson India.	2011

Course Name	:	MARKETING MANAGEMENT
Course Code	:	HSM 405
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of this course is to make students understand about the marketing concepts to be applied in real life and the marketing process for delivering value to customers.

Total No. of Lectures –28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO MARKETING Concepts, Role, Scope and Types of Marketing, Case Study on Marketing Management	3
2	MARKETING RESEARCH Scope and Process of Marketing Research, Hypothetical Marketing Research Analysis	3
3	CONSUMER AND BUSINESS MARKETS Types of Markets, Building Customer Value Consumer and Business Buying Behaviour: Factors Influencing Behaviour and Buying Decision Process	4
4	SELECTION OF MARKETS Segmentation: Factors and Bases, Targeting and Positioning Preparation of STP of Selected Product	3
5	MARKETING MIX 7 P's of Marketing Mix: Product, Price, Physical Distribution, Promotion, People, Process and Physical Evidence Formulation of Marketing Mix of Selected Product	3
6	PRODUCT DECISIONS Product (Good or Service) Characteristics, Product Life-Cycle, Packaging and Branding, Product Development and Management	3
7	PRICING DECISIONS Pricing Policies and Strategies, Factors Influencing Pricing	3
8	PHYSICAL DISTRIBUTION DECISIONS Marketing Channels, Channel Players, Physical Distribution, Managing Distribution, Analysis of Supply Chain Management – Case Studies	3
9	PROMOTION DECISIONS Nature of Promotion Decisions, Managing Mass Communication and Personal Communication Analysis of Promotional Strategies – Case Studies	3

Course Outcomes:

1	The students will learn how to market goods and services effectively to different segments so as to deliver value to customers.
2	The students will be able to formulate marketing mix and marketing strategies for different products and different sets of customers.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Marketing Management: Concepts, Cases, Challenges and Trends”, Govindarajan M, 2 nd Edition, Pubs: PHI Learning.	2009
2	“Marketing Management”, Kotler P., Keller K.L., Koshy A. and Jha M., 14 th Edition, Pubs: Pearson India.	2012
3	“Marketing Concepts and Strategies”, Dibb S., Simkin L., Pride W.M. and Ferrell O.C., Pubs: Cengage Learning.	2012
4	“Marketing Management”, Kumar A. and Meenakshi N., 2 nd Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2011
5	“Marketing Management”, Saxena R., 4 th Edition, Pubs: McGraw Hill Education (India).	2013
6	“Marketing: Managerial Introduction”, Gandhi J.C., 1 st Edition, Pubs: McGraw Hill	1987

	Education.	
7	“Marketing”, Etzel M.J., Walker B.J., Stanton W.J. and Pandit A., 14 th Edition, Pubs: McGraw Hill Education (India).	2010
8	“Super Marketwala: Secrets to Winning Consumer India”, Mall D., 1 st Edition, Pubs: Random House India.	2014

Course Name	:	HUMAN RESOURCE MANAGEMENT
Course Code	:	HSM 406
Credits	:	3
L T P	:	2-1-0

Course Objectives:

The main aim of this course is to provide an overview of HRM, keeping the Indian business scenario in the background and to acquaint the students with the strategic role of HRM in managing an organization.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT HRM: Nature, Scope, Functions, HRM Practices and Problems in India with Case Studies	4
2	HUMAN RESOURCE PLANNING (HRP) Concept and Process of HRP, Factors Affecting HRP	3
3	JOB ANALYSIS AND DESIGNING Uses and Process of Job Analysis, Job Description and Job Specification: Features and Hypothetical Formulation, Job Designing: Job Enrichment, Job Enlargement	3
4	RECRUITMENT AND SELECTION Recruitment: Sources and Methods Selection: Selection Process, Selection Tests, Types and Nature of Interviews Role Playing and Case Study on Selection Process, Tests and Interview	4
5	INDUCTION AND INTERNAL MOBILITY Induction Programme, Need and Scope of Internal Mobility: Transfer, Promotion, Demotion	3
6	TRAINING AND DEVELOPMENT Training: Need and Methods, Management Development: Need, Methods and Management Development Programme HRM Games for Development of Employees	4
7	PERFORMANCE APPRAISAL AND COMPENSATION Nature and Methods of Performance Appraisal, Hypothetical Performance Appraisal Compensation: Financial and Non-Financial Benefits	4
8	EMPLOYEE HEALTH AND SAFETY Concept, Issues related to Health and Safety, Workplace Health Hazards	3

Course Outcomes:

1	The students will develop the ability to solve problems in area of HRM in organizations.
2	The students will become aware of latest developments in HRM practices which are essential for effective management in organization.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Human Resource Management: Text and Cases”, Rao V.S.P., Pubs: Excel Books.	2002

2	“Human Resource Management”, Dessler G. and Varkkey B., 12 th Edition, Pubs: Pearson India.	2011
3	“Human Resource Management: Text and Cases”, Aswathappa K., 7 th Edition, Pubs: McGraw Hill Education (India).	2013
4	“Human Resource Management: Text and Cases”, Gupta C.B., 14 th Edition, Pubs: Sultan Chand and Sons.	2012
5	“Human Resource Management: Text and Cases”, Bedi S.P.S. and Ghai R.K., Pubs: Bharti Publications.	2012
6	“Human Resource Management Applications: Cases, Exercises, Incidents and Skill Builders”, Fottler M.D., McAfee R.B. and Nkomo S.M., 7 th Edition, Pubs: Cengage Learning.	2013

ENGINEERING SCIENCE COURSES

Course Name	:	COMPUTER PROGRAMMING (BASIC)
Course Code	:	CSN104
Credits	:	4
L T P	:	3 0 2

Course Objectives:

To develop logical skills so that students should be able to solve basic computing problems.
To learn the syntax and usage of C programming constructs.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO PROGRAMMING Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System softwares like operating system, compiler, linker, loader; Application programs like editor. Algorithm, specification of algorithm. Flowcharts.	4
2	PROGRAMMING IN C Data types in C, Formatted input-output for printing integer, floating point numbers, characters and strings.	2
3	OPERATORS AND EXPRESSION Expressions in C and their evaluation. Precedence and associativity rules. Operators: arithmetic operators, relational operators, logical operations, bitwise operators, miscellaneous operators.	6
4	STATEMENTS Decision making structures: if, if-else, nested if and if-else, switch. Control structures: for, while, do-while. Role of statements like break, continue, goto.	6
5	ARRAYS Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays.	6
6	FUNCTIONS Advantage of modularizing C program into functions, function definition and function invocation. Methods of passing parameters to a function: call-by-value, call-by-reference; Passing arrays to functions, Recursion, Library functions.	4
7	POINTERS Pointer declaration and initialization, constant pointers, pointers to constant objects, pointer arithmetic, relationship between pointer and arrays.	4
8	SCOPE AND LIFETIMES Scope and lifetime of a variable, storage classes: auto and typedef.	2
	USER-DEFINED DATA TYPES Structures- definition, declaration, use, accessing structure members directly or through pointer structure, structure having arrays and pointers as members, self referential structures, passing structures to functions. Unions: definition, declaration, use, accessing union members directly or through pointer structure.	6
	FILES Concepts of files and basic file operations.	2

Course Outcomes:

1	The student will demonstrate proficiency in C programming language.
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Text Books:

1	Let Us C, Yashwant Kanetkar, BPB Publications
2	Programming in C: A practical approach, Ajay Mittal, Pearson Education

Reference Books:

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1	The C programming language, Kernighan Ritchie, Pearson Education
2	Programming in ANSI C, Balaguruswamy, Tata McRaw Hill
3	Computing Fundamentals, Peter Nortan, Tata McRaw Hill

Course Name	:	COMPUTER PROGRAMMING (ADVANCED)
Course Code	:	CSN105
Credits	:	4
L T P	:	3 0 2

Course Objectives:
To develop logical skills so that students should be able to solve basic computing problems.
To learn the syntax and usage of C programming constructs at advanced level.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO STRUCTURED PROGRAMMING Introduction to topics: decision making, Iteration, functions: functions with variable number of arguments, multiple file programs, concept of linking.	6
2	ARRAYS Array declaration and use, Two-dimensional arrays and multi-dimensional arrays. Strings and Character arrays. Operations on arrays such as insertion, searching, sorting, merging.	6
3	POINTERS Pointer expression, pointer arithmetic, pointer to array, pointer to functions, dynamic memory allocation, dynamic allocation of arrays. Call functions through function pointers, Accessing members of arrays through pointers.	6
4	PREPROCESSOR DIRECTIVES Introduction, Various preprocessor directives, macros with and without arguments, conditional compilation.	6
5	STRUCTURE, UNION, ENUMERATION AND BIT-FIELDS Definition, declaration and initialization, structures containing arrays, array of structures, structure having structures, pointers to structures, self-referential structures, dynamic allocation of structures; Unions: Definition, declaration and initialization. Concepts of interrupts interrupt programming, enumerations and bit-fields.	8
6	FILES Concept of file, file operations, text mode and binary mode, command line arguments.	4
7	INTRODUCTION TO OBJECT ORIENTED PROGRAMMING Classes and objects, basic features of object oriented programming like encapsulation, abstraction, polymorphism, etc.	3
8	APPLICATIONS Projects related to the development of Terminate and Stay resident (TSRs), graphical applications, text-editors, etc.	3

Course Outcomes:
1 The student will demonstrate proficiency in C programming language.

Text Books:
1 Let Us C, Yashwant Kanetkar, BPB Publications
2 Programming in C: A practical approach, Ajay Mittal, Pearson Education

Reference Books:
1 The C programming language, Kernighan Ritchie, Pearson Education
2 Programming in ANSI C, Balaguruswamy, Tata McRaw Hill

3	Computing Fundamentals, Peter Norton, Tata McRaw Hill
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Course Name	:	ENGINEERING DRAWING
Course Code	:	ESC 101
Credits	:	4
L T P	:	2-0 -4

Course Objectives:
At the end of this course, the student should be able to understand the basic concepts of Engineering Drawing. The student should be able to visualize and draw the two and three dimensional objects. The student should also be able to apply drafting softwares in various types of problems.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	Introduction to Engg. Graphics, System of Projections, Orthographic projections, Lettering, Dimensioning rules	2
2	Projections of points and lines, Projection of lines on different planes, Traces and true length of the lines	2
3	Projections of planes/laminae on reference planes, classification of Primary and secondary planes, examples	2
4	Classification of solids, Projections of solids on the basis of positions of the axis of various solids on reference planes	3
5	Sectioning of solids, True and apparent sections, sectioning on the basis of position of section planes	3
6	Developments of surfaces, Parallel line, Radial line and Triangulation methods of development of right and oblique solids	3
7	General introduction to Perspective projection, isometric views, Isometric lines & Axes, Four centre and off set method of drawing ellipse from circle, conversion of orthographic views to isometric views and vise-versa	3
8	Introduction to AutoCAD software for drawing of 2D projections, practical exercises on points, lines, planes and solids	10

List of Experiments:		Number of Turns
1	Exercises on projection of Points on drawing sheets	1
2	Exercises on projection of lines on drawing sheets	1
3	Exercises on projection of planes on drawing sheets	1
4	Exercises on projection of solids on drawing sheets	2
5	Exercises on sections of solids on drawing sheets	1
6	Exercises on Developments of surfaces and Isometric projections on drawing sheets	2
7	Practice of exercises on points and lines using AutoCAD software	1
8	Practice of exercises on planes using AutoCAD software	2
9	Practice of exercises on solids and developments using AutoCAD software	2
10	Practice of exercises on isometric projections using AutoCAD software	1

Course Outcomes: At the end of this course, the students will be able to:	
1	Understand the basic concepts of Engineering Graphics.
2	Visualize the actual objects and convert them in to readable drawings.
3	Understand the drawing standards, conventions and symbols that are in common usage.
4	Draw the common Engineering drawings using available drafting softwares.
5	Come up with innovative conceptual ideas by using Drafting softwares.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Engineering Drawing”, P. S. Gill, S.K. Kataria & Sons	2012
2	“Engineering Drawing”, D.A. Jolhe, Tata McGraw Hill	2010
3	“Engineering Graphics with Auto CAD”, James Bethune, Prentice Hall, India	2003

Course Name	:	FLUID MECHANICS
Course Code	:	ESC102
Credits	:	4
L T P	:	3 0 2

Course Objectives:	
To learn the basic concept of fluid mechanics. To understand the analytical method of solving fluid mechanics problem	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Fluids, Brief history of Fluid Mechanics, Properties of Fluid, Viscosity, Capillarity, Surface Tension, Compressibility, Normal and Shear Stresses in Fluid Flows, Regimes of Flow	4
2	FLUID STATICS Pascal’s Law of measurement of pressure, Types of forces on a fluid system, manometers and gauges, forces on partially and fully submerged bodies including that on curved surfaces, Buoyancy, stability of floating bodies, centre of gravity, Metacentric height.	6
3	KINEMATICS OF FLUID FLOW Langrangian and Eulerian methods, description of properties in a moving fluid, local and convective acceleration, Streamlines, Path lines, Streak lines, Laplace equation, Stream function, velocity potential and flownets.	4
4	DYNAMICS OF FLUID FLOW Equation of conservation of mass, differential form of continuity equation. External forces, Euler’s equation of motion, Bernoulli’s equation, simple application to one dimensional flow, linear momentum and angular momentum, momentum theorem, moment of momentum theorem	8
5	VISCOUS FLOW Pressure gradient in steady uniform flow, flow between parallel plates, Qualitative aspects of viscous flows, Hagen-Poiseulli’s flow, Transition from laminar to turbulent flow, turbulent flow in circular pipe, Navier Stokes equation (without derivation).	5
6	FLOW THROUGH PIPES Introduction, energy and hydraulics grade line, non-dimensional formulation of the pipe flow problem, head losses in pipes & pipe fittings, pipe in series & parallel, reservoir problem.	5
7	DIMENSIONAL ANALYSIS AND SIMILITUDE Buckingham’s Theorem, non-dimensional groups, Geometric, Kinematic and Dynamic Similarity, Hydraulic Models.	4
8	FLOW MEASUREMENT Venturimeter, orifice meter, Pitot tube, Orifices, mouth pieces, notches, weirs, Current meter.	6

List of Experiments:

1	Flow Measurement by Orifice Meter
2	Flow Measurement by Venturimeter
3	Flow Measurement by V Notche
4	Computation of various coefficients involving in through orifice.
5	Determination of friction factors of pipes Minor losses in pipes
6	Determination of friction factors of pipes
7	Verification of Bernoulli's theorem
8	To determination of the metacentric height of a given vessel under unloaded condition.

Course Outcomes:

1	To apply the learned techniques in real life problems related to fluid mechanics.
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Text Books:

1	G.L. Asawa, "Experimental Fluid Mechanics-Volume I" Nem Chand & Brothers
2	B. S. Kapoor, "Manual of Fluid Mechanics" Khanna Publishers
3	S. Singh, "Experiments in Fluid Mechanics-Second Edition" PHI Publications

Reference Books:

1	Frank M. White, "Fluid Mechanics", McGraw Hill.
2	H. Rouse, "Elementary Mechanics of Fluids"
3	Streeter, V.L., "Fluid Mechanics" McGraw Hill Co
4	Lewitt, E.H., "Hydraulics and the Mechanics of Fluids" Pitman

Course Name	:	INTRODUCTION TO MANUFACTURING
Course Code	:	ESC 103
Credits	:	4
L T P	:	2-0-4

Course Objectives:

At the end of the course the students should be able to describe the properties of engineering materials and different manufacturing processes. The students should be able to select appropriate manufacturing process and manufacture a job in the different shops and areas of applications.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Classification of manufacturing processes, classification of engineering materials, comparison of material properties of metals, ceramics and plastics, crystal structures, strain hardening effects, stress-strain curves. Safety measures in workshop.	3
2	MATERIALS AND HEAT TREATMENT Objective of heat treatment, classification of heat treatment, annealing, normalizing, hardening & tempering, case hardening, carburizing, nitriding, flame hardening, induction hardening, applications of heat treatment.	4
3	FOUNDRY Pattern, properties of pattern material, types of pattern, cores. Types of sand, moulding sand ingredients. Types of moulding processes. Types of casting processes: sand casting, shell casting, investment casting and centrifugal casting. Casting defects & remedies. Case studies and applications.	4
4	FORMING Metal forming, types and applications, hot & cold working, forging, drawing, rolling and sheet metal operations.	3

5	MACHINING Metal removal processes, machines, single-point tool, cutting tool geometry, lathe - types, elements and main parts of lathe, drilling, milling and grinding machines. Applications.	3
6	FINISHING Surface finishing processes, principle and applications, lapping, honing, super finishing, polishing, buffing, electroplating, galvanizing.	2
7	WELDING Classification of welding processes, mechanism of arc formation, arc welding processes, gas welding, and resistance welding, principles and applications, welding defects, causes and remedies. Soldering and brazing. Applications and case studies in welding.	3
8	PLASTICS MANUFACTURING Types and properties of plastics, thermosetting and thermoplastic resins, elastomers. Fabrications of plastics, injection moulding, blow moulding, extrusion moulding etc.	2
9	MODERN MANUFACTURING PROCESSES Introduction, classification, electric discharge machining (EDM), electro chemical machining (ECM), laser beam machining (LBM) and Rapid Prototyping Techniques. Case studies on modern and hybrid manufacturing processes.	2
10	CASE STUDIES Considerations of selecting manufacturing processes for industrial products like compact disc, PCB and emerging technological applications.	2

List of Experiments:		Number of Turns
1	To prepare half lap T & L joint in the carpentry shop.	1
2	To prepare the pattern of half nut in carpentry shop.	1
3	To prepare cube from a piece of round bar in forging shop.	1
4	To study the lathe, milling, planer, and shaper operations.	1
5	To manufacture a multi-operational job on lathe/milling in the machining shop.	1
6	To prepare series and parallel wiring connections in the electrical shops.	1
7	To prepare the butt joint by SMAW in welding shop.	1
8	To prepare the mould of a given pattern in foundry shop.	1
9	To cast the prepared mould in foundry shop.	1
10	To prepare a square job in the fitting shop.	1
11	To prepare rectangular box in sheet-metal shops.	1
12	To prepare different joints in the sheet-metal shop.	1

Course Outcomes: By the end of this course, the students will be able to:	
1	Compare the properties of the engineering materials.
2	Select the appropriate manufacturing process for a given job/ application.
3	Identify the advantages and limitations of different manufacturing processes.
4	
5	

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Manufacturing Engineering and Technology”, Serope Kalpakjian and Steven Schmid, Pearson Publications.	2009
2	“A Textbook of Production Technology: Manufacturing Processes”, P. C. Sharma, S. Chand & Company Ltd.	2004
3	“Foundry, Forming and Welding”, P.N. Rao, Tata M/C Graw Hill Publication.	2007
4	DeGarmo, Materials and Processes In Manufacturing, John Wiley & Sons	2011

Course Name	:	THERMODYNAMICS
Course Code	:	ESC 201
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the student should be able to, Understand the basic principles of Thermodynamics and to give students a feel for how Thermodynamics is applied in Engineering practices.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	BASIC CONCEPTS :Macroscopic and Microscopic Approach, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Thermodynamic Equilibrium, State, Path, Process, cycle, Quasi-static Process, Reversible and Irreversible Process, Working Substance. Thermodynamic Properties like Pressure, Volume and Temperature, Zeroth Law of Thermodynamics. Temperature Scales, Concept of Heat and work in Thermodynamics.	8
2	FIRST LAW OF THERMODYNAMICS: Joule’s Paddle wheel Experiment; Mechanical Equivalent of Heat, First Law for a closed system undergoing a Cycle, First Law for a closed system undergoing a change of state. Different forms of stored Energy, Enthalpy, Energy of An isolated System, Perpetual Motion Machine of First kind.	6
3	FIRST LAW APPLIED TO FLOW PROCESSES: Flow Process and Control Volume, flow work, Steady and Unsteady Flow Process, Steady Flow Energy Equation, Engineering Applications of Steady Flow Energy Equation, Throttling Process, Flow Work and Non Flow work, Variable flow Processes, Limitation of First Law.	5
4	SECOND and THIRD LAW OF THERMODYNAMICS: Qualitative Difference between Heat and Work, Thermal Reservoir, Statements of 2nd Law by Max.Planck and Claussius, Equivalence between two statements, Energy Analysis of Heat Engine, Refrigerator and Heat Pump Reversibility and Irreversibility, Causes of Irreversibility Carnot Theorem, Carnot cycle, Absolute Thermodynamic Temperature, Scale, Efficiency of the Reversible Heat Engine, Equality of Ideal Gas Temperature and Kelvin Temperature.	8
5	ENTROPY: Classius Theorem, Classius Inequality and concept of Entropy, Entropy change in an Irreversible Process, Application of Entropy Principle, Entropy Transfer with Heat Flow, Entropy generation in closed and open System, Thermodynamics Equations relating properties of System, Reversible Adiabatic work in a Steady flow System. Entropy and direction, Entropy and disorder.	5
6	PROPERTIES OF GASES AND GAS MIXTURE : Equation of state of a gas, Properties of Mixture of gases, Internal Energy, Enthalpy and Specific heat of gas, mixtures, Entropy of gas Mixtures.	3
7	STEAM GENERATORS: Classification of steam generators, Boiler mountings and accessories. Principles and operations of steam accumulators. Description of Cochran, Locomotive, Lancashire, Babcock and Wilcox boiler, Modern high pressure boilers, Characteristics and advantages of high pressure boilers.	7
8	BASIC CONCEPTS :Macroscopic and Microscopic Approach, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Thermodynamic Equilibrium, State, Path, Process, cycle, Quasi-static Process, Reversible and Irreversible Process, Working Substance. Thermodynamic Properties like Pressure, Volume and Temperature, Zeroth Law of Thermodynamics. Temperature Scales, Concept of Heat and work in Thermodynamics.	8
9	FIRST LAW OF THERMODYNAMICS: Joule’s Paddle wheel Experiment; Mechanical Equivalent of Heat, First Law for a closed system undergoing a Cycle, First Law for a closed system undergoing a change of state. Different forms of stored Energy, Enthalpy, Energy of An isolated System, Perpetual Motion Machine of First kind.	6

Course Outcomes:		
1	A fundamental understanding of various Laws of thermodynamics and their applications.	
2	Understand the efficiencies of Heat Engines and other Engineering Devices.	
3	Understand the working principles and applications of various types of steam generators.	
Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Engineering Thermodynamics”, Gordon Rogers & Yon Machew	2006
2	“Thermodynamics”, Yunus Cengel and Mike Boles	2006
3	“Thermodynamics”, Arora.	2005
4	“Engineering Thermodynamics”, P.K. Nag	2010
5	“Thermo dynamics”, Dr. D.S. Kumar	2012

Course Name	:	ESSENTIALS OF INFORMATION TECHNOLOGY
Course Code	:	ESC202
Credits	:	4
L T P	:	3 1 0

Course Objectives:	
The students should be able to understand the concepts of networking, RBMS, Software Engineering and Web Technology.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	NETWORKING AND COMMUNICATION Introduction to digital communication: Signal propagation, signal types, signal parameters, Channel effect on transmission. Physical layer characterization: Types of transmission media, physical layer interfaces. Data transmission mechanisms: Communication modes, transmission modes, synchronization, introduction to packet switching, multiplexing, error control methods. Network architectures: Introduction to computer networks, Network topologies, Types of networks: LAN, WAN, MAN, layered network model. Internet Protocols: Introduction, Transport layer protocols: TCP, UDP. Application layer protocols: DNS, SMTP, POP, IMAP. Practical aspects of networking.	12
2	RELATIONAL DATABASE MANAGEMENT SYSTEM RDBMS- data processing – the database technology – data models- ER modeling concept – notations – converting ER diagram into relational schema - Logical database design - normalization (1NF, 2NF and 3NF). SQL – DDL statements – DML statements – DCL statements - Joins - Sub queries – Views - Database design Issues – SQL fine tuning.	10
3	WEB TECHNOLOGIES AND INTRODUCTION TO USER INTERFACE AND WEB TECHNOLOGIES Web fundamentals – types web content – HTML – text formatting tags in HTML – HTML form elements - <div> and tags - text formatting using CSS : embedded CSS, inline CSS and external CSS – JavaScript and its features.	10
4	SOFTWARE ENGINEERING Software Engineering : Definition – role of software and software crisis – SDLC models : waterfall model, incremental model and spiral model – software testing – static & dynamic testing – types testing : unit testing, integration testing, system testing, performance testing and regression testing.	10

Course Outcomes: At the end of the course, students will be able to:	
1	Document artifacts using common quality standards
2	Design simple data store using RDBMS concepts

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Andrew S. Tanenbaum , Structured Computer Organization , PHI, 4th edition	2010
2	John L. Hennessy, David Goldberg, David A. Patterson, Computer Architecture : A Quantitative Approach, 2nd Edition Published by Morgan Kaufman Publishers	2008
3	Henry F Korth, Abraham Silberschatz, "Database system concepts", Second ed., McGraw-Hill International editions, Computer Science series	2006
4	A. Tanenbaum, Computer Networks, 5 th Edition	2010
5	William Stallings, Data and Computer Communications, 10 th Edition	2013

Course Name	:	MATERIALS SCIENCE
Course Code	:	ESC 203
Credits	:	04
L T P	:	3 1 0

Course Objectives:
The student will be able to know the concepts of atomic bonding, crystal structures, imperfections, diffusion, mechanical properties, electron energy, and dislocations as related to processing and performance of engineering material

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION Historical perspective, Scope of Materials Science and engineering, Geometry of crystals, Structure determination by X-Ray Diffraction, Atomic structure and chemical bonding, Structure of solids	10
2	IMPERFECTIONS IN ATOMIC AND IONIC ARRANGEMENTS Point defects, Dislocations, Significance of Dislocations, Influence of Crystal structure, Surface defects, Importance of defects	4
3	PHASE DIAGRAMS Phase rule, Single component systems, Binary Phase diagrams, Microstructural changes during cooling, The lever rule, Some typical phase diagrams, Other applications of Phase diagrams	4
4	DIFFUSION IN SOLIDS Applications of Diffusion, Stability of atoms and ions, Mechanism for Diffusion, Activation energy for Diffusion, Rate of Diffusion (Fick's First Law), Factors affecting Diffusion, Composition Profile (Fick's Second Law), Diffusion and Materials Processing	4
5	SOLIDIFICATION Nucleation, Applications of Controlled Nucleation, Growth mechanisms, Solidification time and Dendrite size, Cast structure, Solidification defects, Solidification of Polymers and Inorganic glasses	4
6	ELASTIC, ANELASTIC AND VISCOELASTIC BEHAVIOUR Atomic model of elastic behaviour, The modulus as a parameter in design, Rubber-like elasticity, Relaxation processes, Spring-Dashpot model	4
7	MECHANICAL BEHAVIOUR OF MATERIALS	4

	Plastic deformations and creep in crystalline materials, Fracture	
8	ELECTRONIC AND MAGNETIC BEHAVIOUR OF MATERIALS Conductivity of metals and alloys, Superconductivity, Semiconductors and their applications, Insulators and Dielectrics, Classification of magnetic materials, Magnetization, Permeability and magnetic field, Applications of magnetic materials	4
9	OVERVIEW OF MATERIALS Metals, Ceramics, polymers and composites	4

Course Outcomes:	
1	The student will be able to develop structure-processing-properties co-relationships of materials.
2	The student will be able to describe various phenomena based on the concepts of solidification, Diffusion, mechanical behaviour of materials and compare characteristics of different types of materials such as metals, ceramics, polymers and composite

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Materials Science and Engineering-A First course/ V Raghavan/PHI	2013
2	Materials Science and Engineering, an Introduction/William D. Callister/ John Willey and Sons Inc. Singapore.	2007
3	Principles of Materials Science and Engineering/William Fortune Smith/TataMcGraw- Hill	1990
4	The Science and Engineering of Materials, Donald R Askeland&Pradeep P Phule/ Cengage Learning	2006

Course Name	:	SOLID MECHANICS
Course Code	:	ESC 204
Credits	:	4
L T P	:	3 1 0

Course Objectives:	
At the end of this course the student will be able to understand the basic concepts of behavior of the materials and analysis the basic structural elements like beams, columns, trusses and circular shafts. The student will be able to apply this knowledge for the design of various civil engineering structures.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	PROPERTIES OF MATERIALS Introduction, uni-axial tension test, idealized stress- strain diagrams, isotropic, linear, elastic, visco-elastic and plastic materials, compression test, impact test, fatigue test, torsion and bending test.	4
2	SIMPLE STRESSES & STRAINS Concept of stresses and strains, relationship between elastic constants, extension of uniform bar & tapered bar under its own weight and due to load applied, stresses produced in compound bars due to axial loads, thermal stresses,	4
3	COMPOUND STRESSES: General state of stress, resultant stress and strain circle, principal stresses and principal strains, Mohr's circle for compound stresses and strains	4
4	SHEAR FORCE AND BENDING MOMENT IN BEAMS Shear force, bending moment, Relation between load, SF and BM, SFD, BMD and axial force diagram for determinate beams under various types of loading.	6

5	BENDING AND SHEAR STRESSES IN BEAMS Pure bending ,bending stresses, eccentric loading combined bending and direct stresses , Middle Third rule, composite beams, Variation of shear stresses for various cross-sections of a beam.	5
6	ANALYSIS OF PLANE TRUSSES Different types of trusses, Analysis of plane trusses by method of joints and method of sections.	5
7	TORSION Torsion equation for circular shaft , shafts under action of varying torque, torsion of composite shafts.	4
8	COLUMNS & STRUTS Criteria for stability of columns, Buckling of columns, Euler's theory for various end restraints, Rankine's formula, eccentrically loaded struts, struts with initial curvature, struts with lateral loading.	5
9	DEFLECTION OF BEAMS Slope and Deflection in beams by double integration method, Macaulay's method, Moment area method under the action of various loading conditions; slope and deflection in built in and propped beams.	5

Course Outcomes: By the end of this course the student will be able to:	
1	Analysis the simple civil engineering structures under different loading conditions.
2	Understand the behaviour of basic structural elements.
3	Apply this knowledge for the design of various civil engineering structures.
4	
5	

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"An introduction to the Mechanics of Solids", Crandall & Dahi, McGrawHill.	1978
2	"Strength of Material", G.H. Ryder, MacMillan.	2002
3	"Mechanics of Solids", E.P. Popov, Pearson Education.	1978
4	"Mechanics of Materials", E.J. Hearn, Elsevier Publications.	2001
5	"Mechanics of Materials", Punmia and Jain, Laxmi Publications (P) Ltd.	2013
6	"Mechanics of Materials", R.C.Hibbeler, Pearson Higher education.	2013
7	"Strength of Materials", S. Ramammurtham and R. Narayanan, Dhanpat Rai Publishing Comp	2014

Course Name	:	INTRODUCTION TO ELECTRONICS
Course Code	:	ESC 205
Credits	:	4
L T P	:	3-1-0

Course Objectives:	
At the end of this course, the student should be able to	
1. Identify active and passive components and to solve simple electronic circuits.	
2. Explain the fundamental concepts of basic semiconductor devices & digital electronics.	
3. Describe the basic principle of operational amplifier along with its applications, A/D, D/A conversion and architecture of 8085 microprocessor.	
4. Define the communication system and list the various modulation techniques.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO ELECTRONICS: Need and application of electronics in different areas, Basic elements of electronic system (Active and Passive elements, Sources, Dependent Sources), KVL and KCL	3
2	SEMICONDUCTOR DEVICES: Concept of active and passive devices, Semiconductor Devices: Structure, principle of operation, characteristics and applications of PN-Junction (Rectifier, Clipper and Clamper), BJT, Current Components in BJT, Input & Output characteristics Common Emitter (CE), Common Base (CB), Common Collector (CC) configurations, BJT as an amplifier, Construction, working principle and characteristics of FET and MOSFET, Concept of feedback amplifier, Barkhuasen criteria, Oscillators, 555 timer as multivibrator, Four layer devices- SCR, DIAC and TRIAC (Construction, operation and characteristics)	15
3	DIGITAL PRINCIPLES: Digital waveforms, digital logic, moving and storing digital information, digital operations, digital integrated circuits	3
4	OPERATIONAL AMPLIFIER AND ITS APPLICATIONS: Block diagram, characteristics, inverting and non inverting configurations, Opamp as summing amplifier, difference amplifier, integrator, differentiator	5
5	A/D AND D/A CONVERTERS: Basic principle and characteristics, Weighted resistor D/A converter, Binary ladder D/A converter, counter ramp type A/D Converter	4
6	INTRODUCTION TO MICROPROCESSOR: Pin diagram, Architecture of 8085 Microprocessor, Concept of Microcontroller and its applications	3
7	COMMUNICATION SYSTEMS: Introduction to communication system, communication time line, Various frequency bands used for communication, Block diagram of Analog and Digital communication, need of modulation, Analog modulation techniques (Amplitude and frequency), Digital modulation techniques (PCM,PWM,PPM, PAM, ASK,FSK,PSK, QAM), Introduction to advanced communication systems (Optical and wireless).	9

Course Outcomes: By the end of the course the students will be able to	
1	Identify the various electronic devices and predict their behavior in an electronic system.
2	Draw the architecture of Microprocessor.
3	Differentiate between various modulation techniques in a communication system and relate them to practical systems.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky (PHI)	2009
2	Digital principles & applications, Malvino Leach, TMH	2011
3	Microprocessor Architecture programming and Applications with 8085 by R Gaonkar, Penram International Publishing Pvt ltd.	2002
4	Circuits and Networks: Analysis and Synthesis, Sudhakar and ShyamMohan, TMH	2009
5	Electronic Communication Systems by G. Kennedy, Mc Graw Hill, 4th Edition	2008
6	Electronic Communications, 4th Edition, Roddy & Coolen.	2009

Course Name	:	BASIC ELECTRICAL SCIENCES
Course Code	:	ESC 206
Credits	:	04
L T P	:	3- 0-2

Course Objectives:

At the end of this course, the student should be able to acquire knowledge of analytical techniques to solve electrical circuits, basic electrical machines, and electrical measuring instruments.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	BASIC DEFINITIONS AND NETWORK THEOREMS Basic definitions of voltage, current, power and energy. Nodes, branches, loops, mesh, Kirchhoff 's laws, nodal & mesh analysis. Circuit theorems: linearity, superposition, Norton, thevenin, max power transfer.	8
2	AC CIRCUITS Introduction, Generation of alternating voltage, sinusoidal waveform, phasor diagram, power relations in AC circuits, single phase AC circuits, Steady State Analysis: Nodal and Mesh analysis, Thevenin's, Norton's, Maximum Power Transfer theorems. AC Power Analysis: Instantaneous and average power, max average power transfer, RMS value, apparent power and power factor, complex power, conservation of AC power. THREE PHASE CIRCUITS: Phase sequence, Star and delta connection, Relation between line and phase voltages and currents in balanced systems, Analysis of balanced and Unbalanced three phase circuits, Measurement of active and reactive power.	10
3	MAGNETICALLY COUPLED CIRCUITS Mutual Inductance, Energy in a coupled circuit. Transformer : construction, equivalent circuit, voltage regulation, efficiency, OC and SC tests.	5
4	DC MACHINES Construction, emf and torque equations, circuit model, methods of excitation, characteristics of generators and motors, starting and speed control of dc motors, starters, losses, efficiency.	5
5	AC MACHINES Rotating magnetic field theory, three phase induction machines: General construction features, per phase equivalent circuit, approximate equivalent circuit, production of torque, slip, torque speed characteristics, no load and blocked rotor test to determine performance parameters, Starting: rotor rheostat starter, reduced voltage starting, star delta starting, centrifugal start. Synchronous motors: types, salient pole and cylindrical rotor, emf equation. Principle of operation of single phase induction motor, types and applications.	10
6	BASIC MEASURING INSTRUMENTS Introduction, Classification of instruments, essential features and operating principles, moving coil and moving iron instruments.	4

List of Experiments:		Number of Turns
1	Verification KCL and KVL	01
2	Verification of Ohm's Law	01
3	Verification of the principle of , superposition with ac and dc sources	01
4	Verification of Thevenin, and Nortan theorems.	01
5	Verification of maximum power transfer theorem in dc circuit.	01
6	To study resonance in series and parallel RLC circuits and plot various responses.	01
7	To verify the line voltage and phase voltage , and line current and phase current relationship in a star and delta three phase balanced circuit.	01
8	Measurement of active and reactive power in single-phase ac circuit.	01
9	To perform open and short circuit test on a 1-phase transformer and determine its equivalent circuit and efficiency	01
10	To study dc machine and determine open circuit characteristic.	02
11	To perform open circuit test and block rotor test on a 3 phase IM to draw equivalent circuit.	01
12	To perform load test on D.C. shunt motor.	01

Course Outcomes: By the end of this course, the student will be able to:

1	Apply different techniques to solve electrical circuits.
2	Acquire the knowledge of electrical machines and electrical measuring instruments.
3	Design and conduct experiments, as well as analyze and interpret data.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Fundamentals of Electric Circuits by Charles K Alexander and Matthew N O Sadiku, Mc Graw Hill Higher Education, 5 th edition, ISBN 0073380571.	2012
2	Network Analysis & Synthesis by FF Kuo, Wiley International	1966
3	Electric Machinery and Transformers by Bhag S Guru & Huseyin R Hiziroglu, Oxford University Press, ISBN 0195138902.	1988
4	Semiconductor Physics and Devices: Basic Principles by Donald A Neamen, Irwin Professional Publishing, 3 rd Revised edition, ISBN 0256242143	2006

Course Name	:	MECHATRONICS
Course Code	:	ESC 207
Credits	:	04
L T P	:	3-1-0

Course Objectives:
At the end of this course the student should be able to have basic knowledge of mechatronics and its interdisciplinary applications i.e. integration of Mechanical engineering with Electrical& Electronics Engineering and Computer Technology. He should be able to design and conduct experiments as well as to analyze and interpret data.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO MECHATRONICS Understanding Mechatronics. Key Elements of Mechatronics, Components of Mechatronics ,Human Being and Mechatronic System, Conventional and Mechatronic Approach, Advantages of Mechatronic Systems. Definition of System, Classification of System, Mechanistic System, Mechatronic System Intelligence.	04
2	SENSOR AND TRANSDUCERS: PRINCIPLES AND APPLICATIONS Role of Sensors and transducers in Mechatronics System , selection of sensors based on performance characteristics, static and dynamic characteristics); calibration; types of sensors , resistive transducers, inductive ,capacitive ,optical , thermal Transducer and their applications ,Measurement of : linear , angular position, displacement, rotational speed, force, pressure, strain, flow rate, temperature etc..	08
3	SIGNAL CONDITIONING DEVICES Role of signal conditioning Processes and devices in mechatronics, passive elements (RLC), semiconductors devices (PN junction diodes, AC rectification, Zener diode, Power supplies, transistors, Transistor (common emitter characteristics, emitter, follower circuit, FET); thyristor, TRIAC,DIAC, operational amplifiers (inverting, unity gain, non-inverting, C/V and V/C amplifiers, differential amplifier, instrumentation amplifier).Filters types of filters. SIGNAL CONVERTING DEVICES: Digital to analog converter (DAC) and Analog to Digital Converter (ADC), multiplexer.	09
4	DIGITAL ELECTRONICS Boolean algebra; digital electronic gates; combination logic systems (simple gates, NAND and NOR gates, latches, positive and negative logic, tri-state logic); sequential logic systems	05

	(J-K flip-flop, registers and counter, timers and pulse circuits).	
5	MICROPROCESSORS , MICROCONTROLLERS AND PLC'S Fundamentals of microprocessor , the 8085, concept of interfacing memory, input /output devices , fundamentals of Microcontroller, T he 8051, PLC Hardware, PLC Memory structure, application	07
6	ACTUATORS Role of actuators in mechatronics, types of actuators, electrical actuators Physical principles; solenoid-type devices; DC machines; AC machines; stepper motors .Drive Technology Applications: Linear motors; voice coil motors; electro-pneumatic and electro-hydraulic actuators. Mechanical actuators :Rotary to linear motion conversion; power transmission, Electromechanical System Applications, Coupling, gearing, belts, pulleys, bearings.	07
7	CASE STUDIES Washing Machines, auto focusing camera, pick and place robot.	02

List of Experiments:		Number of Turns
1	To study various types of Resistors, Inductors, Capacitors, Diodes, Transistors, LED.	01
2	To study CRO, Function generator, Power Supply.	01
3	To study various components of Induction Machine and Synchronous Machine	01
4	To study various components of DC Machines and Transformers.	01
5	To obtain output voltage waveforms of half wave and full wave uncontrolled rectifier with and without filter capacitor.	02
6	To design a voltage regulator using Zener Diode and analyze the performance of the regulator for various loads. Also compare the performance with a linear voltage regulator.	02
7	To verify truth-tables of various flip-flops (J-K, D, Toggle etc.)	01
8	To study the characteristics of LVDT using linear displacement trainer Kit & compare with ideal characteristics.	01
9	To measure the strain of the metal strip using strain gauge trainer kit & compare with ideal characteristics.	01
10	To measure the angular displacement of resistive & capacitive transducer using angular displacement trainer kit & compare with ideal characteristics.	01
11	To obtain the characteristics of RTD, Thermistor, thermocouple with hot and cold junction thermal trainer kit & compare with ideal characteristics.	01

Course Outcomes: By the end of this course, the student will be able to:	
1	Students were able to have basic knowledge of mechatronics and its interdisciplinary applications i.e. integration of Mechanical engineering with Electronics
2	Students were able to design and conduct experiments

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Mechatronics, fourth edition, by W Bolton. ISBN 978-81-317-3253-3	2013
2	Dan Neculescu Mechatronics published by Pearson Education (Singapore) Pvt. Ltd., Indian Branch, 482 FIE, Patparganj, Delhi India.	2001
3	Book by H M T Limited, Mechatronics Tata McGraw Hill Publishing Company Limited, New Delhi.	1988
4	Mechatronics Principles, Concepts & Applications by Nitaigour P Mahalik published by TMH	2003

Course Name	:	MECHANICAL ENGINEERING DRAWING
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Course Code	:	ESC
Credits	:	4
L T P	:	2-0-4

Course Objectives:

At the end of this course, the student should be able to visualize objects and their graphical representations, understand the various engineering drawing symbols, conventions and other requirements of assembly and dis-assembly of mechanical engineering parts and materials and should be able to draw clear and understandable production drawings.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO ENGINEERING GRAPHICS: System of Projections. Technical lettering. Drawing conventions, Orthographic projections. 3-views. Projection of oblique areas. Circular features. Dimensioning, Rules of dimensioning.	3
2	ISOMETRIC PROJECTIONS: General introduction to Isometric Projections. Conversion from orthographic to isometric projections and vice-versa. Freehand sketching.	3
3	Projections of Points, Lines and Planes. Geometrical Constructions.	5
4	Projection of Solids, sectioning. Auxiliary planes and views.	3
5	REQUIREMENTS OF MECHANICAL ENGINEERING DRAWINGS: Conventional representation, Layout of drawing sheet, symbols of standard tolerances, machining symbols. Introduction and familiarization of the code IS:296.	3
6	FASTENERS: Temporary and Permanent fasteners. Various types of screw threads, nuts and bolts, screws, welding joints and riveted joints.	3
7	INTRODUCTION TO AUTOCAD: Basic commands and features, simple exercises of points, lines, planes and solids on AutoCAD.	3
8	ASSEMBLY AND DIS-ASSEMBLY DRAWING EXERCISES ON SOME OF THE FOLLOWING USING DRAWING SHEETS AS WELL AS AUTOCAD: Couplings, Clutches, Knuckle and cotter joints, Pipe and pipe fittings, IC engine parts, Machine tool parts, Bearings, Screw Jack, Drill press vice.	5

List of Experiments:		Number of Turns
1	Drawing exercises on lettering, dimensioning, points, lines and planes	3
2	Drawing exercises on solids, sectioning and auxiliary planes	3
3	Drawing exercises on isometric and orthographic projections	2
4	Introduction to AutoCAD, familiarization with basic commands and features	2
5	Simple exercises of points, lines, planes, solids and sectioning of solids on AutoCAD	2
6	Drawing of machine parts on AutoCAD	2

Course Outcomes: By the end of this course, student will be able to

1	Have knowledge of drawing symbols, conventions and methods of graphical representations.
2	Understand various machine components, their working and functions.
3	Able to read and understand mechanical engineering drawings.
4	Have working knowledge of the drafting package AutoCAD.
5	Able to understand and draw mechanical engineering drawings on AutoCAD.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Engineering Drawing by R. K. Dhawan	2012
2	Machine Drawing by R. K. Dhawan	2012

3	Engineering Drawing by P. S. Gill	2013
4	Machine Drawing by P. S. Gill	2013
5	Fundamentals of Engineering Drawing by Luzadder and Duff	2009
6	Engineering Graphics with AutoCAD by James D. Bethune	2011

TECHNICAL COMMUNICATION

Course Name	:	TECHNICAL COMMUNICATION
Course Code	:	XXX-205
Credits	:	2
L T P	:	0-0-3

Course Objectives:

At the end of the course the students should be able to effectively communicate as per their professional requirements.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Need for Effective Communication, Overview of Technical and Professional communication	3
2	Listening Skills, Reading Skills, Writing Skills	3
3	<u>Writing</u> Letters, Official E-mails, Job Applications, Resumes, Cover Letters, Notes. Case Studies	6
4	Overview of Research Writing. Information Gathering; Using the Library and Internet Modes, Organizing and Presenting According to Audience and Purpose. Writing Research Proposals, Project Technical Report/ Dissertation/Theses Writing. Case Studies.	12
5	Presentation Skills, Interview Skills, Group Discussion skills, Case Studies.	9
6	Technology Based Communication- Use of Visuals and Audio to Communicate Effectively.	3
7	Ethics, Attitude and Team Communication	3
8	Social Media/ Online Communication, Public Speaking; Developing an Authorial Voice	3

Course Outcomes: By the end of this course the student will be able to

1	Develop effective technical communication.
2	Write technical documents in a professional manner.
3	Present professional requirements in an effective manner

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Meenakshi Raman and Sangeeta Sharma, “Fundamentals of Technical Communication”, Oxford University Press, India	2014
2	Barun K Mitra, “Effective Technical Communication- A Guide for Scientists and Engineers” ,Oxford University Press, India	2006
3	David f Beer and David McMurrey, “ Guide to Writing as an Engineer” ,2 nd ed., Wiley	2004
4	Diane Hacker, “ Pocket Style Manual”, Bedford/St martin’s.	2003

Course Name	:	OPERATIONS RESEARCH
Course Code	:	MAN 401
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course , the students should be able to describe the need of Operations Research, develop the ability to form Mathematical models of Optimization problems, identify and solve linear models of Optimization problems, apply and to describe the limitations of classical methods to solve non-linear models of Optimization problems, apply and to describe the limitations of The Transportation Model ,Decision theory, Queuing Model.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scientific method in Operations Research, Necessity of Operations Research in industry, Scope of Operations Research	6
2	Formulation of Linear Programming problem , Graphical Solution, Simplex Method, Unrestricted variables, Artificial variables, M-Method, Dual Phase method	12
3	Introduction to the Transportation model, Assumption in the Transportation Model, Definition of the Transportation Model, Matrix terminology, Formulation and solution of Transportation Model	6
4	Decision theory, Steps in Decision theory approach, Decision making environments, Decision making under conditions of certainty, Decision making under conditions of uncertainty, Decision making under conditions of risk, Maximum likelihood criterion	6
5	Queuing Model, Introduction, Application of Queuing Model, Elements of Queuing System, Operating characteristics of Queuing System, Waiting time and idle time costs.	6
6	Non – Linear Programming, Introduction , Local and Global optimum, Concave and Convex functions, Types of non-linear programming problems.	6

Course Outcomes: By the end of this course, the students will be able to :

1	Form Mathematical model of Optimization problems
2	Distinguish between linear and non-linear models
3	Solve simple problems of The Transportation Model
4	Solve simple problems of Decision theory
5	Solve simple problems of Queuing Model

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Operations Research” , Ravindran , Phillips , and Solberg , 2 nd edition, John Wiley & sons .	2000
2	“Engineering Optimization” , S S Rao , 3 rd edition, New Age .	2000
3	“Operations Research” , Kantiswarup, Gupta P.K. & Sultan Chand & Sons .	2007
4	“Operations Research” , Sharma S.D., Kedarnath, Ramnath & Company .	1994
5	“Operations Research” , Bronson R, Shaum’s Outline Series .	1997

Course Name	:	OPTIMIZATION TECHNIQUES
Course Code	:	MAN 402
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the student should be able to describe the need of Optimization Techniques, develop the ability to form mathematical model of optimization problems, identify and solve linear models of optimization problems, apply and to describe the limitations of classical methods to solve nonlinear models for optimization problems, apply and to describe the limitations of gradient based and direct iterative methods to solve nonlinear problems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	LINEAR PROGRAMMING Formulation, Graphical solution, Simplex method, Relation between Graphical and Simplex method, Unrestricted variables, Artificial variables, M-Method and Dual Phase method	(14)
2	OPTIMIZATION TECHNIQUES UNCONSTRAINED PROBLEMS - (Single and multivariable optimization) Necessary and sufficient conditions for extreme points CONSTRAINED PROBLEMS - (multivariable optimization) Equality constraints, Jacobian and Lagrangean methods, Application of Jacobian method to linear problems	(12)
3	NON-LINEAR PROGRAMMING PROBLEMS Geometric Programming UNCONSTRAINED ALGORITHMS – Direct methods, Dichotomous and Golden search; Univariate and Hooke and Jeeves search methods; Gradient methods, Cauchy's steepest ascent method and Newton's method.	(12)
4	PROGRAMMING TECHNIQUES Separable programming, Geometric Programming	(4)

Course Outcomes:

1	Form mathematical model of optimization problems
2	Distinguish between linear and nonlinear models.
3	Solve simple problems using classical / iterative methods.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Operations Research, Ravindran, Phillips, and Solberg, 2 nd edition 2000, John Wiley & sons.	2000
2	Operations Research by Hamady Taha, 8th edition	
3	Engineering Optimization, S S Rao, 3 rd edition 2000, New Age.	2000
4	Operations Research 9th Edition, Kantiswarup, Gupta P.K. & Sultan Chand & Sons.	
5	Operations Research 8th Edition, Sharma S.D., Kedarnath, Ramnath & Company.	
6	Operations Research 2nd Edition, Bronson R, Shaum's Outline Series.	
7	P. Sankara Iyer, "Operations Research", Tata McGraw-Hill, 2008.	2008
8	J K Sharma., "Operations Research Theory & Applications, 3e", Macmillan India Ltd, 2007	2007
9	P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & co., 2007.	2007

Course Name	:	ADVANCED PHYSICS
Course Code	:	PYN-401
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems in Nuclear and Solid State physics.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Quantum theory of light, X-rays - production, spectrum & diffraction(Bragg's Law), photoelectric effect, Compton effect, pair production, photons & gravity, black holes, de-Broglie hypothesis, particle diffraction, uncertainty principle and applications. Postulates of quantum mechanics, Schrodinger theory, time-dependent and time-independent Schrodinger equation, wave function, Born interpretation and normalization, expectation values.	10
2	Particle in a box (infinite well potential), finite potential step and barrier problems, tunneling, linear harmonic oscillator (one-dimensional). Hydrogen atom, radiative transitions and selection rules, electron spin, Stern-Gerlach experiment, Spin-orbit coupling, exclusion principle, symmetric and anti-symmetric wave functions. Alpha decay, Zeeman Effect, Correspondence Principle, Angular Momentum in Quantum Mechanics.	10
3	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions. Artificial radioactivity and its application, Beta-decay (energy spectrum & discovery of neutrino), fusion reactions in stars.	10
4	Band theory of solids, Kronig-Penney Model (qualitative), conductors, insulators and semiconductors, p-type and n-type semiconductors, statistics of electrons and holes, Hall effect (for single as well as both type of charge carriers).	6
5	Occurrence of superconductivity, destruction of superconductivity, Meissner effect, type I and type II superconductors, heat capacity, isotope effect, thermodynamical considerations, London equations & penetration depth, coherence length, BCS theory (elementary description), applications of superconductors. High temperature superconductivity, Josephson junctions.	6

Course Outcomes: By the end of this course:

1	Students will be able to solve numerical problems in Quantum Mechanics, Nuclear and Solid State Physics.
2	Students will be aware of latest developments in certain areas of Physics like condensed matter physics, superconductivity etc. which have important applications for societal needs.
3	Students will be able to correlate the various phenomena with quantum mechanical concepts.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Concepts of Modern Physics”, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013
2	“Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013

3	“Introductory Nuclear Physics”, Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014
4	“Modern Physics”, J. Bernstein, P.M. Fishbane and S.G. Gasiorowicz, Pearson, Education India Pvt. Ltd., New Delhi	2009

Course Name	:	CRYSTAL PHYSICS
Course Code	:	PYN-402
Credits	:	4
L T P	:	3 1 0

Course Objectives:		
During this course students will understand basics of crystal structure and correlate the same with different material properties. They will be able to describe the concepts of lattice dynamics and crystal binding forces and correlate the same with thermal properties.		

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	CRYSTAL STRUCTURES - Periodic array of atoms, Lattice, basis, primitive cell, two and three dimensional lattice types, miller indices, examples of crystal structures (NaCl, CsCl structures), Hexagonal closed packed, diamond, zinc sulfide structures, x-ray diffraction of crystal, Bragg's Law, reciprocal lattice, diffraction condition, Laue equation, structure factor, atomic form factor.	12
2	CRYSTAL BINDING - van der waals interaction, repulsive interaction, equilibrium lattice constant, cohesive energy, ionic crystals, covalent crystals, electrostatic energy, Madelung constant.	10
3	PHONONS AND CRYSTAL VIBRATIONS - monoatomic basis, first Brillouin zone, dispersion relation, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonon.	10
4	THERMAL PROPERTIES - phonon heat capacity, density of states, Einstein model, Debye model of heat capacity, inharmonic crystal interaction, thermal expansion. Thermal conductivity, Umklapp Processes.	10

Course Outcomes: By the end of the course	
1	Students will be able to solve the problems based on crystal structure and thermal properties of solids
2	Understand and apply the basic concepts of crystal binding and crystal vibrations in different phenomena.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Introduction to Solid State Physics”, Charles Kittel, Wiley India Pvt. Ltd., New Delhi	2012
2	“Solid State Physics”, S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	“Crystallography Applied to Solid State Physics”, Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	:	SOLID STATE PHYSICS
Course Code	:	PYN-403
Credits	:	4
L T P	:	3 1 0

Course Objectives:

During this course students will understand basics of free electron theory. They will study the origin of energy gaps on the basis of quantum mechanics approach. They will cover advance topics in dielectrics. Superconductivity will also be covered and student's interest will be created in possibility of high temperature superconductivity.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Free electron theory, energy levels in one dimension, free electron gas in three dimension, heat capacity of electron gas, electrical conductivity and ohm's law, experimental electrical resistivity of metals, Hall Effect.	12
2	Energy bands, origin of energy gap, bloch functions, Kronig-Penny model, brillouin zones, metals and insulators.	10
3	Dielectric function of the electron gas, plasma optics, dispersion relation of electromagnetic wave, transverse optical modes in plasma, longitudinal plasma oscillations, polaritons, electron-phonon interaction polarons, optical processes and excitons.	12
4	Occurrence of superconductivity, destruction of superconductivity, Meissner effect, type I and type II superconductors, heat capacity, isotope effect, thermodynamical considerations, London equations & penetration depth, coherence length, BCS theory (elementary description), applications of superconductors. High temperature superconductivity, Josephson junctions.	8

Course Outcomes: By the end of the course, student will be able to

1	Solve the problems based on free electron theory and band theory of solids.
2	Understand and apply the basic concepts of plasma optics and superconductivity in different phenomena.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Introduction to Solid State Physics", Charles Kittel, Wiley India Pvt. Ltd., New Delhi	2012
2	"Solid State Physics", S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	"Crystallography Applied to Solid State Physics", Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	:	MODERN INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS
Course Code	:	CHN 401
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course, the student should be able to introduce the principles of chemical analysis, matrix effects, detailed instrumentation, operation and interpretation of data, error analysis and statistical methods of data handling.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	SPECTROSCOPIC TECHNIQUES: UV – Visible, Infra red, NMR, and Mass Spectroscopy-Principles Instrumentation and Applications	10
2	ATOMIC ABSORPTION SPECTROMETRY AND EMISSION SPECTROMETRY: Inductively coupled plasma atomic emission spectroscopy (ICP-AES) - Principles	8

	Instrumentation and Applications	
3	OPTICAL MICROSCOPY: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Transmission Electron Microscopy (STEM) -Principles and Applications	6
4	X-RAY TECHNIQUES: XRD, XRF, XPS-Principles and Applications	8
5	THERMAL ANALYSIS: DTA, TGA- Principles Instrumentation and Applications	5
6	CHROMATOGRAPHIC ANALYSIS: GC, HPLC- Principles Instrumentation and Applications	5

Course Outcomes: By the end of this course, the student will be able to:	
1	Handle the analysis of mg, ppm and ppb levels of analyte by appropriate instrumental methods.
2	Carry out Chemical analysis of hazardous materials, environmental samples, inorganic, organic and biomaterials at trace and ultra trace quantities.
3	Differentiate among molecular absorption, atomic absorption and atomic emission spectrometry.
4	Carry out hands on experiments in the field related to analysis of materials required for technological developments and in advanced research in Engineering.
5	Differentiate between classical and instrumental methods of Chemical analysis.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Interpretation of Mass Spectra", McLafferty F.W., 3rd Edition, Pubs: W.A. Benzamine, New York.	1993
2	"Spectrometric Identification of Organic Compounds", Silverstein R.M. and Bassler G.S., 5th Edition, Pubs: John Wiley.	1991
3	"Instrumental Analysis", Willard H.H., Merritt L.L. and Dean J.A., 7 th Edition, Pubs: Van Nostran Reinhold.	1998
4	"Instrumental Analysis", Skoog D.A. Holler F. J. and Crouch S. R., Pubs: Brooks/Cole.	2007
5	"Analytical Chemistry", Christian G.D., 5 th Edition, Pubs: John Wiley.	1994
6	"X-ray structure determination a practical guide", Stout G.H. and Jeansen L.H., Pubs: John Wiley & Sons, New York.	1989
7	"Crystal structure analysis for chemists and biologists", Glusker J.P., Lewis M, Pubs: VCH Publisher inc., New York.	1994
8	"Structure Determination by X-ray crystallography", Ladd, M.F.C. and Palmer R.A., Pubs: Plenum Press, New York.	1994

Course Name	:	PRINCIPLES OF MANAGEMENT
Course Code	:	HSM 401
Credits	:	4
L T P	:	2-2-0

Course Objectives:	
The main aim of this course is to make students understand the management process and principles along with its application in practical life and to help them manage different jobs and situations with the help of management functions.	

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO MANAGEMENT Nature of Management: Art or Science, Principles and Functions of Management	3
2	EVOLUTION OF MANAGEMENT THOUGHT Classical Theories: Bureaucratic, Scientific and Administrative Approach	6

	Neo-Classical Theories: Human Relations and Human Behaviour Approach Modern Theories of Management Relevance of Management Thought in present scenario – Management Cases	
3	PLANNING Nature of Planning, Planning Process, Application of Planning Process in a Hypothetical Situation, Types of Planning, Types of Plans, Management by Objective (MBO)	4
4	ORGANIZING Concept of Organization, Departmentation, Forms of Organization Structure Analysis of Organization Structure – Case Studies Hypothetical Formation of an Organization	4
5	STAFFING Human Resource Planning: HRP Process, Job Analysis: Job Description, Job Specifications and Used of Job Analysis Recruitment: Sources and Methods Selection: Selection Process, Role Playing and Case Study on Selection Tests and Interviews Training and Development: Techniques, Performance Appraisal: Methods Case Study on Staffing Practices	6
6	DIRECTING Concept, Leadership: Importance and Styles, Motivation: Theories and their relevance in present scenario, Communication: Process, Types and Barriers of Communication Management Game on Leadership, Motivation and Communication	3
7	CONTROLLING Nature and Process of Controlling, Requirements for Effective Controlling	2

Course Outcomes:

1	The students will be able to apply management concepts and principles in daily life and thus, will be able to manage things efficiently and effectively.
2	The students will learn how to get work done easily by using management knowledge and functions.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Principles and Practices of Management”, Rao V.S.P. and Narayana P.S., Pubs: Konark Publishers.	1987
2	“Principles & Practice of Management”, Prasad L.M., 8 th Edition, Pubs: Sultan Chand & Sons.	2012
3	“Essentials of Management: International and Leadership Perspective”, Wehrich H. and Koontz H., 9 th Edition, Pubs: McGraw Hill.	2012
4	“The New Era of Management”, Daft R.L., 11 th Edition, Pubs: Cengage Learning.	2014
5	“Management: Text and Cases”, Rao V.S.P. and Krishna V.H., Pubs: Excel Books.	2008
6	“Fundamentals of Management: Essential Concepts and Applications”, Robbins S.P, DeCenzo D.A., Bhattacharya S. and Agarwal M.N., 6 th Edition, Pubs: Pearson India.	2009

Course Name	:	BUSINESS ENVIRONMENT AND BUSINESS LAWS
Course Code	:	HSM 402
Credits	:	4
L T P	:	2-2-0

Course Objectives:

The main aim of this course is to make students understand different types of environment influencing business decisions and to provide knowledge about different laws that needs to be followed for initiating and managing business.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO BUSINESS Scope and Characteristics of Business, Classification of Business Activities Forms of Ownership of Business: Sole Proprietorship, Partnership and Company	5
2	BUSINESS ENVIRONMENT Internal Environment: Concept and Elements (Value System, Vision Mission Objectives, Management Structure, Human Resources, Company Image etc.) SWOT Analysis: Concept and Case Study External Environment: Micro Environment (Suppliers, Customers, Competitors, Market Intermediaries etc.) and Macro Environment – PESTEL Analysis (Political, Economic, Social, Technological, Ecological and Legal), Case Study on Impact of Environment on Business	7
3	GLOBALIZATION Concept, Pros and Cons of Globalization, Impact of Global Environment on Business Globalization of Company – Case Study	4
4	CORPORATE SOCIAL RESPONSIBILITY Concept, Social Responsibility towards different stakeholders, Rationale for CSR CSR – Case Studies	2
5	CORPORATE GOVERNANCE Concept, Elements and Essentials of Good Governance	3
6	CONTRACT LAW Concept, Types and Essentials Elements of Contract	3
7	PARTNERSHIP LAW Nature of Partnership, Provisions of Partnership Act, Issues Related to Partnership Firm, Hypothetical Formation of a Partnership Firm	2
8	COMPANY LAW Nature of Company, Provisions of Company Act, Issues Related to Incorporation of Company, Hypothetical Formation of a Company	2

Course Outcomes:

1	The students will be able to analyze the impact of environment on business and formulate appropriate business strategies to compete in the competitive world.
2	The students will learn how companies follow corporate governance and social responsibility practices along with fulfilling economic objectives.
3	The students will gain knowledge about application and implementation of various business laws in practice.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Business Environment: Text and Cases”, Cherunilam F., 22 nd Edition, Pubs: Himalaya Publications.	2013
2	“Legal Aspects of Business”, Pathak A., 5 th Edition, Pubs: McGraw Hill Education.	2013
3	“Essential of Business Environment: Text, Cases and Exercises”, Aswathappa K., 11 th Edition, Pubs: Himalaya Publication.	2011
4	“Business Law Including Company Law”, Gulshan S.S. and Kapoor G.K., 15 th Edition, Pubs: New Age International (p) Ltd.	2011

5	“Business Law and Corporate Laws”, Tulsian P.C., 1 st Edition, Pubs: Sultan Chand Publishing.	2011
6	“Fundamentals of Business Organization & Management”, Bhushan Y.K., 19 th Edition, Pubs: Sultan Chand & Sons.	2013
7	“Corporate Governance: Principles, Policies and Practices”, Fernando A.C., 2 nd Edition, Pubs: Pearson India.	2011

Course Name	:	FINANCIAL MANAGEMENT
Course Code	:	HSM 404
Credits	:	4
L T P	:	2-2-0

Course Objectives:
The main aim of this course is to make students learn different financial decisions i.e. investing, financing and dividend, required to be taken by a company and provide knowledge about the functioning of the financial system (financial markets, financial institutions, financial services and financial instruments) of the country.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO FINANCIAL MANAGEMENT Concept of Finance, Terminology Related to Finance, Financial Decisions, Factors Affecting Financial Decisions, Risk-Return Trade-Off	3
2	FINANCIAL SYSTEM Concept and Role of Financial System in Indian Economy	2
3	FINANCIAL MARKETS AND INSTRUMENTS Concept and Relevance of Money Market and Capital Market Money Market Instruments: Call Money, Treasury Bills, Commercial Papers, Certificate of Deposits Capital Market Instruments: Equity Shares, Preference Shares and Debentures Hypothetical Trading in Financial Markets	5
4	FINANCIAL SERVICES Nature and Functions of Financial Services: Merchant Banking, Mutual Funds, Factoring, Forfaiting, Credit Rating Case Study on Financial Services	6
5	FINANCIAL INSTITUTIONS Nature and Functions of Financial Institutions: Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Discount and Finance House of India (DFHI)	2
6	LONG TERM INVESTMENT DECISIONS Capital Budgeting: Concept, Importance, Factors Techniques/Methods with Numerical Applications (Pay Back Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return and Profitability Index), Case Study	3
7	SHORT TERM INVESTMENT DECISIONS Working Capital: Nature, Type and Factors Affecting the Requirement of Working Capital, Case Study	2
8	FINANCING DECISIONS Capital Structure: Essentials and Approaches of Capital Structure Sources of Finance (long-term and short-term), Financial Leverage: Concept and Numerical Application, Case Study	3
9	DIVIDEND DECISIONS Types of Dividend, Dividend Policy: Nature and Factors Affecting Dividend Policy, Case Study	2

Course Outcomes:	
1	The students will learn to make best combination of financial decisions by considering risk and return trade-off.
2	The students will identify how business can gain maximum through the financial system.
3	The students will understand how to manage funds effectively so as to maximize returns.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Financial Management”, Shah P., 2 nd Edition, Pubs: Dreamtech Press	2009
2	“Financial Markets and Services”, Gordon E. and Natarajan K., 3 rd Edition, Pubs: Himalaya Publishing House.	2006
3	“Financial Management: Theory and Practice”, Chandra P., 8 th Edition, Pubs: McGraw Hill Education (India).	2012
4	“Financial Management”, Pandey I.M., 10 th Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2010
5	“Cases in Financial Management”, Pandey I.M. and Bhat R., 3 rd Edition, Pubs: McGraw Hill Education (India).	2012
6	“Financial Institutions and Markets: Structure, Growth and Innovations”, Bhole L.M. and Mahakud J., 5 th Edition, Pubs: McGraw Hill Education (India).	2009
7	“The Indian Financial System: Markets, Institutions and Services”, Pathak B.V., 3 rd Edition, Pubs: Pearson India.	2010
8	“Financial Management and Policy”, Horne J.C.V. and Dhamija S., 12 th Edition, Pubs: Pearson India.	2011

Course Name	:	MARKETING MANAGEMENT
Course Code	:	HSM 405
Credits	:	4
L T P	:	2-2-0

Course Objectives:
The main aim of this course is to make students understand about the marketing concepts to be applied in real life and the marketing process for delivering value to customers.

Total No. of Lectures –28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO MARKETING Concepts, Role, Scope and Types of Marketing, Case Study on Marketing Management	3
2	MARKETING RESEARCH Scope and Process of Marketing Research, Hypothetical Marketing Research Analysis	3
3	CONSUMER AND BUSINESS MARKETS Types of Markets, Building Customer Value Consumer and Business Buying Behaviour: Factors Influencing Behaviour and Buying Decision Process	4
4	SELECTION OF MARKETS Segmentation: Factors and Bases, Targeting and Positioning Preparation of STP of Selected Product	3
5	MARKETING MIX 7 P's of Marketing Mix: Product, Price, Physical Distribution, Promotion, People, Process	3

	and Physical Evidence Formulation of Marketing Mix of Selected Product	
6	PRODUCT DECISIONS Product (Good or Service) Characteristics, Product Life-Cycle, Packaging and Branding, Product Development and Management	3
7	PRICING DECISIONS Pricing Policies and Strategies, Factors Influencing Pricing	3
8	PHYSICAL DISTRIBUTION DECISIONS Marketing Channels, Channel Players, Physical Distribution, Managing Distribution, Analysis of Supply Chain Management – Case Studies	3
9	PROMOTION DECISIONS Nature of Promotion Decisions, Managing Mass Communication and Personal Communication Analysis of Promotional Strategies – Case Studies	3

Course Outcomes:	
1	The students will learn how to market goods and services effectively to different segments so as to deliver value to customers.
2	The students will be able to formulate marketing mix and marketing strategies for different products and different sets of customers.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Marketing Management: Concepts, Cases, Challenges and Trends”, Govindarajan M, 2 nd Edition, Pubs: PHI Learning.	2009
2	“Marketing Management”, Kotler P., Keller K.L., Koshy A. and Jha M., 14 th Edition, Pubs: Pearson India.	2012
3	“Marketing Concepts and Strategies”, Dibb S., Simkin L., Pride W.M. and Ferrell O.C., Pubs: Cengage Learning.	2012
4	“Marketing Management”, Kumar A. and Meenakshi N., 2 nd Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2011
5	“Marketing Management”, Saxena R., 4 th Edition, Pubs: McGraw Hill Education (India).	2013
6	“Marketing: Managerial Introduction”, Gandhi J.C., 1 st Edition, Pubs: McGraw Hill Education.	1987
7	“Marketing”, Etzel M.J., Walker B.J., Stanton W.J. and Pandit A., 14 th Edition, Pubs: McGraw Hill Education (India).	2010
8	“Super Marketwala: Secrets to Winning Consumer India”, Mall D., 1 st Edition, Pubs: Random House India.	2014
Course Name	:	HUMAN RESOURCE MANAGEMENT
Course Code	:	HSM 406
Credits	:	4
L T P	:	2-2-0

Course Objectives:	
The main aim of this course is to provide an overview of HRM, keeping the Indian business scenario in the background and to acquaint the students with the strategic role of HRM in managing an organization.	

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT HRM: Nature, Scope, Functions, HRM Practices and Problems in India with Case Studies	4

2	HUMAN RESOURCE PLANNING (HRP) Concept and Process of HRP, Factors Affecting HRP	3
3	JOB ANALYSIS AND DESIGNING Uses and Process of Job Analysis, Job Description and Job Specification: Features and Hypothetical Formulation, Job Designing: Job Enrichment, Job Enlargement	3
4	RECRUITMENT AND SELECTION Recruitment: Sources and Methods Selection: Selection Process, Selection Tests, Types and Nature of Interviews Role Playing and Case Study on Selection Process, Tests and Interview	4
5	INDUCTION AND INTERNAL MOBILITY Induction Programme, Need and Scope of Internal Mobility: Transfer, Promotion, Demotion	3
6	TRAINING AND DEVELOPMENT Training: Need and Methods, Management Development: Need, Methods and Management Development Programme HRM Games for Development of Employees	4
7	PERFORMANCE APPRAISAL AND COMPENSATION Nature and Methods of Performance Appraisal, Hypothetical Performance Appraisal Compensation: Financial and Non-Financial Benefits	4
8	EMPLOYEE HEALTH AND SAFETY Concept, Issues related to Health and Safety, Workplace Health Hazards	3

Course Outcomes:	
1	The students will develop the ability to solve problems in area of HRM in organizations.
2	The students will become aware of latest developments in HRM practices which are essential for effective management in organization.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Human Resource Management: Text and Cases”, Rao V.S.P., Pubs: Excel Books.	2002
2	“Human Resource Management”, Dessler G. and Varkkey B., 12 th Edition, Pubs: Pearson India.	2011
3	“Human Resource Management: Text and Cases”, Aswathappa K., 7 th Edition, Pubs: McGraw Hill Education (India).	2013
4	“Human Resource Management: Text and Cases”, Gupta C.B., 14 th Edition, Pubs: Sultan Chand and Sons.	2012
5	“Human Resource Management: Text and Cases”, Bedi S.P.S. and Ghai R.K., Pubs: Bharti Publications.	2012
6	“Human Resource Management Applications: Cases, Exercises, Incidents and Skill Builders”, Fottler M.D., McAfee R.B. and Nkomo S.M., 7 th Edition, Pubs: Cengage Learning.	2013

Course Name	:	MANAGING INNOVATION AND CHANGE
Course Code	:	HSM 431
Credits	:	4
L T P	:	2-2-0

Course Objectives:	
The main aim of this course is to make students learn how to manage innovation and change in organizations and understand how innovation and change can contribute to business success.	

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO INNOVATION AND CHANGE Concept, Types, Sources, Components, Invention vs. Innovation	4
2	INNOVATION IN ORGANIZATION Innovation in Managerial Functions (Planning, Organizing, Staffing, Directing and Controlling), Innovation in Operational Functions (Marketing, Human Resource and Finance) Case Studies and Brainstorming Sessions	3
3	INNOVATION POLICY Innovation Cluster, National Innovation Systems	3
4	INNOVATION MANAGEMENT Innovation Management: Innovation Strategies, Models, Processes and Structures Case Study on Innovation Management	4
5	REACTIONS TO CHANGE Process of Planned Change, Responses to Change, Reasons for Resistance to Change, Change Agents, Stages in Reaction to Change	5
6	CHANGE MANAGEMENT Key Dimensions and Factors, Organizational Change, Approaches to Change Management Case Study on Change Management	4
7	INTELLECTUAL PROPERTY RIGHT (IPR) Patents, Copyrights and Trademarks	3
8	DISCUSSIONS ON ADDITIONAL READING (any one of the following in the semester) - 8 Steps to Innovation – Going from Jugaad to Excellence - Innovation Secrets of Indian CEOs - Jugaad Innovation: A Frugal and Flexible Approach to Innovation for the 21 st Century - The Ten Faces of Innovation	2

Course Outcomes:

1	The student will learn the technological, human, economic, organizational, social and other dimensions of innovation.
2	The students will understand how to encourage, manage and implement innovation and change in organization and how to take a new idea to the stage where it can be implemented.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Managing Change and Transition”, Harvard Business School, Pubs: Harvard University Press.	2003
2	“Managing Creativity and Innovation”, Harvard Business School, Pubs: Harvard University Press.	2003
3	“Managing Change, Creativity and Innovation”, Dawson P. and Andriopoulos C., Pubs: Sage Publications.	2014
4	“Managing Strategic Innovation and Change”, Tushman M.L. and Anderson P., 2 nd Edition, Pubs: Oxford University Press.	2004
5	“The International Handbook of Innovation”, Larisa V.S., Pubs: Elsevier Science.	2003
6	“Managing Innovation and Change”, Mayle D., 3 rd Edition, Pubs: Sage Publications.	2006
7	“Managing Technology and Innovation for Competitive Advantage”, Narayanan V.K., Pubs: Pearson India.	2002
8	“Managing Technological Innovation, Competitive Advantage from Change”, Betz F., Pubs: Wiley.	2011

Course Name	:	BUSINESS RESEARCH
Course Code	:	HSM 432
Credits	:	4
L T P	:	2-2-0

Course Objectives:

The main aim of this course is to make students understand the concepts of business research and learn the methods to formulate, analyze and interpret the business problems.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO BUSINESS RESEARCH Concept and Types of Business Research	3
2	PROBLEM IDENTIFICATION Defining Problem, Literature Review: Essentials of Literature Review and Writing of Review, Research Objectives: Essentials of Research Objectives and its Formulation	3
3	FRAMEWORK FOR BUSINESS RESEARCH Research Questions, Hypothesis: Essentials of Hypothesis and its Formulation, Types of Variables	2
4	INTRODUCTION TO RESEARCH DESIGN Purpose and Scope of Research Design, Research Proposal: Elements and Framing a Research Proposal	2
5	MEASUREMENT SCALES Rating Scales, Ranking Scales, Reliability, Validity, Questionnaire: Essentials of Questionnaire, Developing a Questionnaire on a Hypothetical Research Problem	4
6	SAMPLING DESIGN Concept, Process and Techniques of Sampling, Framing of Sampling Design	3
7	DATA COLLECTION Sources and Methods of Data Collection	3
8	PRESENTATION AND ANALYSIS OF DATA Tabular, Graphic and Diagrammatic Presentation of Data, Statistical Data Analysis, Presentations and Analysis of Data using MS Excel	5
9	RESEARCH REPORT Contents and Characteristics of Project Report, Formulation of Project Report	3

Course Outcomes:

1	The students will develop ability to tackle problems in business by following research techniques.
2	The students will learn to collect the right data and to analyze and present the data in the right way.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Research Methods for Business: A Skill Building Approach”, Sekaran U. and Bougie R., 5 th Edition, Pubs: Wiley India Pvt. Ltd., New Delhi.	2011
2	“Research Methodology: Methods and Techniques”, Kothari C.R. and Garg G., 3 rd Edition, Pubs: New Age International.	2014
3	“Business Research Methods”, Bryman A. and Bell E., 2 nd Edition, Pubs: Oxford University Press.	2010
4	“Business Statistics”, Beri G.C., 3 rd Edition, Pubs: McGraw Hill Education (India).	2009
5	“Statistics for Management”, Levin R.I., Rubin D.S., Rastogi S. and Siddiqui M.H., 7 th Edition, Pubs: Pearson India.	2012

6	“Business Research Methods and Statistics using SPSS”, Burns R.P. and Burns R., 1 st Edition, Pubs: Sage Publications.	2008
7	“Statistics for Management”, Srivastava T.N. and Rego S., 2 nd Edition, Pubs: McGraw Hill Education (India).	2012

Course Name	:	ALGEBRA - I
Course Code	:	MAN 431
Credits	:	4
L T P	:	3-1-0

Course Objectives:		
At the end of this course, the students should be able to describe the basic results of Group Theory. They should be able to recognise examples of groups. They should know the definitions of basic terms and should be able to write elements of the symmetric group as cycles or products of transpositions, should know simple uses of Lagrange's Theorem, quotients and products of groups. They should know difference between finding a proof from the axioms that works for all groups, and finding a counter example.		

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Definition of a group, examples, some preliminary lemmas, Subgroups, examples, Cosets, Order of a group, Lagrange's Theorem, Euler's Theorem, A counting principle.	10
2	Normal subgroups and quotient groups, Homomorphism, Cauchy's Theorem, Sylows Theorem, Automorphism, Cayley's Theorem, Permutation groups, Conjugacy classes, Sylow subgroups and Sylow's Theorem,	16
3	Direct products, Finite abelian groups.	6
4	Vector Spaces: Elementary basic concepts, Linear independence and bases, Dual Spaces.	10

Course Outcomes:		
1	By the end of the course, the students will be able to describe the basic results of Group Theory, recognise examples of groups, know the definitions of basic terms, such as: order of a group, order of an element, subgroup, cyclic group and isomorphism. They will also be able to prove simple consequences, write elements of the symmetric group as cycles or products of transpositions, describe quotients and products of groups.	

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Topics in Algebra”, Herstein, I.N., Wiley Eastern Limited, New Delhi.	1981
2	“Modern Algebra”, Singh, S and Zameeruddin, Q, Vikas Publishing House, New Delhi	2015
3	“Rings and Modules”, Musili, C, Narosa Publishing House, (Second Revised Edition), New Delhi.	1994.
4	“Algebra”, Artin, M. Prentice Hall of India, New Delhi.	1994
5	“The Theory of Groups of Finite Order”, Burnside, W. (2nd Ed.), Dover, New York.	1955

Course Name	:	NUMBER THEORY
Course Code	:	MAN 432

Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to describe the fundamental properties of integers and to prove basic theorems. They should be able to solve congruences and Diophantine equations. They should also be able to approximate reals by rationals.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Introduction, Divisibility, Greatest common divisor, The Euclidean algorithm, primes, Fundamental theorem of Arithmetic,	8
2	Congruences, Residue classes and reduced residue classes, Fermat's theorem, Euler's theorem, Wilson Theorem, Solution of congruences, congruences of degree 1, Chinese Remainder theorem with applications. Euler's ϕ -function,	12
3	Congruences of higher degree, prime power moduli, prime modulus, Primitive roots, Indices and their applications, power residues, Quadratic residues, Quadratic reciprocity, Legendre Symbol, Euler's criterion, Gauss's Lemma, Quadratic reciprocity law, Jacobi symbol,	10
4	Greatest integer function, arithmetic function, Mobius inversion formula, Diophantine equations Farey sequences, Continued fractions, approximations of reals by rationals.	12

Course Outcomes: By the end of the course, the students will be able to

1	Describe the fundamental properties of integers.
2	Prove basic theorems.
3	Solve congruences.
4	Solve Diophantine equations
5	Approximate reals by rationals

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"An introduction to theory of numbers", Niven I., Zuckerman S. H. and Montgomery L. H. John Wiley and Sons .	1991
2	"Theory of Numbers", Hardy and Wright W. H. Oxford University Press	1979
3	"Higher arithmetic", Davenport H. Cambridge University Press .	1999.
4	"Elementary Number Theory", David M. Burton, Wm.C. Brown Publishers, Dubuque, Iowa .	1989

Course Name	:	FOURIER SERIES AND INTEGRAL TRANSFORMS
Course Code	:	MAN 433
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of this course, the students should be able to expand functions in Fourier series, Fourier Integrals and learn Fourier sine and cosine Transforms, Harmonic analysis and their applications.
The students should be able to evaluate Laplace transforms and Inverse Laplace transform.
The students should be able to apply Laplace transforms to solve ordinary differential equations.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Periodic functions, Trigonometric series, Fourier Series, Euler's formulae, Conditions for existence of Fourier series, Functions of any period $p = 2L$, Even and odd functions, Half range expansions, Complex Fourier series, Applications of Fourier series, Parseval's identity, Harmonic analysis. Approximation by Trigonometric Polynomials	12
2	Fourier Integral, Fourier Sine and Cosine Integrals ,Evaluation of Integrals, Fourier Transforms, Fourier Cosine Transform, Fourier Sine Transform, Properties of Fourier Transform, Linearity ,Symmetry, change of Time Scale, Time Shifting , Frequency Shifting , Fourier Transform of derivatives, integrals, convolution , Properties of Fourier cosine and sine Transforms, Parseval Identity for Fourier Transform , Finite Fourier Cosine and Sine Transform	18
3	Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, s-Shifting ,t-Shifting, Unit step function, Dirac's delta function, Differentiation and integration of transforms, Applications to differential equations. Convolution Theorem ,Integral Equations	12

Course Outcomes:

1	By the end of this course the students will be able to expand a function in terms of its Fourier Series ,Fourier Integrals, Fourier Transforms and apply harmonic analysis to numerical data.
2	The students will be able to evaluate Laplace transforms and inverse Laplace transforms.
3	The students will be able to use Laplace transform to solve ordinary differential equations arising in engineering problems.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Higher Engineering Mathematics“, B V Ramana, Tata McGraw -Hill	2006
2	“Advanced Engineering Mathematics”, E. Kreyszig, John Wiley.	2006
3	“Advanced Engineering Mathematics”, Wylie and Barrett, McGraw Hill.	2003

Course Name	:	CALCULUS OF VARIATIONS
Course Code	:	MAN 434
Credits	:	4
L T P	:	3-1-0

Course Objectives:

At the end of the course the students should be able to understand the concept of functional, extremum, Euler's equations, the concepts of transversality conditions, Weirstress-Endmann corner condition and canonical form of Euler equations, canonical transformations and Rayleigh Ritz method,They should be able to apply direct methods in calculus of variations Euler's finite difference methods, use Rayleigh Ritz method and Sturm-Liouville to solve differential equations.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Variation of a functional. A necessary condition for an extremum, Euler's equation. Some classical problems. Fixed end point problems for unknown functions. Variational problems	10

	with subsidiary conditions.	
2	General variation of a functional. Variable end point problems, transversality conditions. Transversal theorem. Weirstress-Endmann corner condition. Canonical form of Euler equations and their first integrals. Canonical transformations. Weather's theorem. The principle of the least action. Censervation laws. Hamilton-Jacobi equations. Jacobi's theorem.	14
3	The second variation of a functional and the formula for second variation. Legendre's necessary condition. Iaobi's necessary condition. Conjugate points, Sufficient condition for a weak extremum. General definition of a field and field of a functional. Hilberts invariant integral. The weierstrass E-functional. Sufficient conditions for a strong minimum. Direct methods in calculus of variations Euler's finite difference methods and the Rayleigh Ritz method. Applications to sturm-Liouville problem.	18

Course Outcomes:		
1	At the end of the course the students will be able to understand the concept of functional, extremum, Euler's equations.	
2	They will be able to learn the concepts of transversality conditions, Weirstress-Endmann corner condition and to evaluate canonical form of Euler equations, canonical transformations and Rayleigh Ritz method.	
3	They will be able to apply direct methods in calculus of variations Euler's finite difference methods, use Rayleigh Ritz method and Sturm-Liouville to solve differential equations.	

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Calculus of variations", I M. Gelfand and S. V. Fomin	1963
2	"Calculus of variations", L.E. Elsgolc.	1962

Course Name	:	ALGEBRAIC CODING THEORY
Course Code	:	MAN 435
Credits	:	4
L T P	:	3-1-0

Course Objectives:		
At the end of this course, the students should be able to translate fundamental problems of coding theory into mathematical problems and then solve them by using the theory of finite fields, polynomial rings and finite groups.		

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	INTRODUCTION TO CODING THEORY Source and Channel coding, Error detecting and error correcting codes	2
2	ERROR DETECTION, ERROR CORRECTION AND DECODING Communication Channels, maximum likelihood decoding, Hamming distance, Nearest neighbour/ minimum distance decoding, distance of a code	6
3	FINITE FIELDS Fields, Polynomial rings, Structure of finite fields, Minimal polynomials	10
4	LINEAR CODES Vector spaces over finite fields, Linear Codes, Hamming weight, Bases for linear codes Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbor decoding for linear codes, Syndrome Decoding, Weight Enumerator of a Code, Macwilliam's Identity,	16

5	CYCLIC CODES Definition, Generator polynomials, Generator matrix and parity check matrix, Decoding of linear codes.	8
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Course Outcomes: By the end of the course, the students will be able to

1	Translate fundamental problems of coding theory into mathematical problems and then solve them by using the theory of finite fields, polynomial rings and finite groups.
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Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Coding Theory”, San Ling & Chaoping Xing , Cambridge University Press	2004
2	“Introduction to the ‘Theory of Error Correcting Codes”, Vera Pless, Cambridge University Press	2003
3	“Introduction to Error Correcting Codes”, Raymond Hill, Clarendon Press, Oxford	1986
4	“Theory of Error Correcting Codes Part I & II”, F.J.Macwilliams & NJA Sloane	1977

Course Name	:	QUANTUM MECHANICS
Course Code	:	PYN-431
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Blackbody radiation, photoelectric effect, X-rays, X-ray diffraction, Compton effect, Pair production	7
2	Inadequacy of classical physics, Bohr-Sommerfield quantization rules, Quantum-Mechanical viewpoint.	4
3	De Broglie waves, phase and group velocities, particle diffraction, Uncertainty Principle, limitations on experiment, wave packets.	7
4	One-dimensional Schrodinger wave equation, extension to three dimensional statistical interpretation of wave function, Normalization, expectation value.	6
5	Separation of wave equation, one-dimensional square well potential, perfectly rigid wall, finite potential step, tunnel effect.	8
6	Linear harmonic oscillator, three-dimensional square well potential, the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, Zeeman effect.	10

Course Outcomes: By the end of the course, student will be able to

1	Solve the problems based on Quantum Mechanics.
2	Apply the concepts of Quantum Mechanics in different phenomena.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/
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		Reprint
1	“Concepts of Modern Physics”, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013
2	“Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	“Modern Physics”, J. Bernstein, P.M. Fishbane and S.G. Gasiorowicz, Pearson, Education India Pvt. Ltd., New Delhi	2009

Course Name	:	STATISTICAL PHYSICS
Course Code	:	PYN-432
Credits	:	4
L T P	:	3 1 0

Course Objectives:
The students will be able to describe and implement concepts and principles of Statistical Mechanics required for in depth understanding of Physical phenomena in solid state, nuclear physics.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Laws of Thermodynamics - First Law of Thermodynamics, Second Law of Thermodynamics, Entropy, Third Law of Thermodynamics.	6
	Phase Transitions, Kinetic Theory, Vander waal equation of state, Boltzmann transport equation, Maxwell-Boltzman Distribution, the method of most probable distribution.	8
2	Classical Statistical Mechanics, Microcanonical ensemble, Cnonical ensemble, Grand Canonical ensemble, Chemical Potential.	7
	Distribution function, Ideal Fermi Gas, Degenerate and non-degenerate states, Theory of white dwarf stars, Landau Diamagnetism.	7
3	Equation of state for ideal Fermi gas, quantized Hall effect, Pauli paramagnetism, Ideal Bose gas, Bose-Einstein distribution, Derivation of Planck's Law.	7
	Phonons, Specific heat, superfluids, Landau's theory, superfuid flow, superfuid velocity, Bose-Einstein Condensation.	7

Course Outcomes:	
1	Solve the problems based on Statistical Mechanics.
2	Understand the importance of statistical physics in describing various natural phenomena.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Statistical Mechanics”, K. Huang, Wiley India Private Ltd., New Delhi	2013
2	“Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	“Concepts of Modern Physics”, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013

Course Name	:	NUCLEAR PHYSICS
Course Code	:	PYN-433
Credits	:	4
L T P	:	3 1 0

Course Objectives:

The students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Mass, charge and constituents of nucleus, Nuclear size and distribution of nucleons, Energies of Nucleons, Nucleus as a quantum system, nuclear force, properties of nucleus.	10
2	Particle in a one-dimensional square well, particle in a three-dimensional square well, vector model for addition of angular momentum.	10
3	Bound states of two nucleons - Deuteron nucleus, Meson theory of nuclear forces. Shell theory of nucleus, shell theory potential, allowed orbits, filling of allowed orbits, non-spherical nucleus.	10
4	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions.	12

Course Outcomes: By the end of the course, student will be able to

1	Solve the problems based on Nuclear Physics.
2	Understand and apply the basic concepts of nuclear physics in different nuclear phenomena.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Concepts of Nuclear Physics”, B.L. Cohen, Tata Mcgraw Hill, New Delhi	2013
2	“Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	“Introductory Nuclear Physics”, Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014

Course Name	:	EXPERIMENTAL NUCLEAR PHYSICS
Course Code	:	PYN-434
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Experimental Nuclear Physics Binding energies of nuclei, semi-empirical mass formula, magnetic dipole moment, electric quadrupole moment, Beta decay, nucleon emission, decay laws.	10
2	Experimental method in nuclear physics, interaction of charged particle with matter, detectors for energetic charged particles, detectors which make tracks visually observable, scintillation detectors, charge collection detectors, mass spectrometer.	10
3	Accelerators, linear accelerator, cyclic accelerator, synchrocyclotron.	10
4	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions.	12

Course Outcomes: By the end of the course, student will be able to

1	Solve the problems based on experimental Nuclear Physics.
2	Predict that which type of detector or accelerator is suitable for particular application.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Concepts of Nuclear Physics”, B.L. Cohen, Tata Mcgraw Hill, New Delhi	2013
2	“Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	“Introductory Nuclear Physics”, Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014

Course Name	:	X-Ray Crystallography
Course Code	:	PYN-435
Credits	:	4
L T P	:	3 1 0

Course Objectives:

At the end of the course, student will become familiar with the applications of X-ray crystallography in the determination of molecular structure. On the basis of structure, student will be able to explain the experimental observed properties.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Bonding in Solids, Ionic bonding, Covalent, metallic bonding, intermolecular bond, dispersion bond, hydrogen bond. General features of crystals, basis and crystal structure, unit cell and lattice parameters, external symmetry of crystals, seven crystal systems, thirty two crystal classes, Miller indices, space lattice, symmetry elements, space group.	12
2	General description of scattering process, Thomson scattering, Compton scattering, scattering of X-rays by atoms.	10

3	Diffraction from one-dimensional and three-dimensional array of atoms, reciprocal lattice, Ewald sphere, Laue equation, structure factor, Diffraction by periodic distribution, electron-density equation, Patterson method. Powder camera, oscillation camera, Weissenberg camera.	10
4	Relevance of crystallography in the studies of theory of solids, influence of translational periodicity on the physical behavior of solids, tight binding approximation, density of states,	10

Course Outcomes:

1	Solve the problems based on crystal systems.
2	Apply X-ray crystallography in the determination of molecular structure.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“An introduction to X-Ray Crystallography” by M.M. Woolfson Vikas Publishing House, Cambridge University Press, New Delhi	2012
2	“Solid State Physics”, S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	“Crystallography Applied to Solid State Physics”, Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	:	INORGANIC CHEMISTRY
Course Code	:	CHN-431
Credits	:	4
L T P	:	3 0 3

Course Objectives:

At the end of this course, the students should be able to describe concepts of Inorganic chemistry related to structure, properties & applications of inorganic and organometallic compounds.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	QUANTUM THEORY AND ATOMIC STRUCTURE: Introduction to wave mechanics, the Schrodinger equation, the Schrodinger equation as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals.	4
2	CHEMICAL BONDING: Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.	7
3	THE SOLID STATE: A recapitulation of close packing of spheres, structures of NaCl, CsCl, ZnS, CaF ₂ , crystal defects and applications of defect structures (transistors, rectifiers, photovoltaic cells and computer chips).	4
4	COORDINATION COMPOUNDS: Part 1: Werner's theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series).	6
5	COORDINATION COMPOUNDS: Part2: Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - SN ¹ , SN ²). Magnetic behaviour of	6

	complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism	
6	ORGANOMETALLIC COMPOUNDS: Nomenclature, types of ligands and bonding in organometallic compounds, use of organometallics in industry.	5
7	INORGANIC POLYMERS: Types of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties.	5
8	ROLE OF METALS IN BIOLOGICAL SYSTEMS: Bio-inorganic Chemistry of Iron – Heme proteins & Non-Heme iron proteins; bioinorganic chemistry of cobalt-vitamin B12 and metalloenzymes.	5

List of Experiments:		Number of Turns
1	Estimation of oxalate using potassium permagnate.	1
2	Estimation of Fe ²⁺ and Fe ³⁺ using potassium dichromate.	1
3	Estimation of Cu ²⁺ and AsO ₃ ³⁻ iodimetrically.	2
4	Determination of Zn by EDTA titration.	1
5	Estimation of Ba ²⁺ /SO ₄ ²⁻ by as BaSO ₄ gravimetrically.	1
6	Estimation of Fe ²⁺ and Fe ³⁺ as Fe ₂ O ₃ gravimetrically.	2
7	Preparation and characterization of inorganic complexes (2 nos.).	2
8	Preparation and characterization of organometallic compound.	1
9	Crystallization techniques for purification of inorganic complexes.	1
10	Melting point determination of few inorganic compounds.	1

Course Outcomes: By the end of this course, the student will be able to:	
1	Understand the structure of atom based on quantum theory, concept of chemical bonding in homo- and hetro-atomic molecules & structure of advanced materials along with their applications in electronic fields.
2	Apply the thermodynamic, kinetic, magnetic and mechanistic aspects to coordination compounds.
3	Develope organometallic compounds to study the interaction and role of metals in biological systems essential for bio-engineering applications.
4	Design new inorganic materials with in-depth understanding of their structures and properties.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Inorganic Chemistry”, A. G. Sharpe., 3rd Edition, Longman Publishers ELBS.	1992
2	“Inorganic Chemistry”, J. D. Lee, 5th Edition, Chapman and Hall Publishers.	1996
3	“Advanced Inorganic Chemistry”, F. A. Cotton & G. Wilkinson, 3rd Edition, Wiley Eastern Ltd.	1982
4	“Basic Inorganic Chemistry”, F. A. Cotton & G. Wilkinson; Wiley Eastern Ltd.	1987
5	“Inorganic Polymer”, J. Mark, R. West & H. Allcock, Prentice Hall, New Jersey Publishers.	1982
6	“Vogel’s Qualitative Inorganic Analysis”, G. Svehla, 7 th Edition Pearson Education.	2002

Course Name	:	
Course Code	:	
Credits	:	
L T P	:	

Course Objectives:

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Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	Ultrasonics Production, detection and uses of ultrasonics, reverberation, sabine's formula (no derivation)	(3)
2		
3		
4		

List of Experiments:		Number of Turns
1		
2		
3		
4		
5		

Course Outcomes:	
1	
2	
3	
4	
5	

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“ Computer Graphics”, Donald Hearn and M. Pauline Baker, Pearson Education	2012
2		
3		
4		
5		

Course Name	:	ANALYTICAL CHEMISTRY
Course Code	:	CHN-433
Credits	:	4
L T P	:	310

Course Objectives:
At the end of this course, the student should be able to develop sufficient knowledge about the major instrumental methods of chemical analysis so that they can determine what technique should be used for study of structural aspects of all kinds of materials. The student will be able to analyze the advances in instrumentation which have been made, especially those made as a result of problems encountered with the method. Students will gain practical knowledge of experimental methods and analytical instrumentation for carrying out analytical separations using gas and liquid chromatography.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	COMPLEXOMETRIC TITRATIONS : Complexes-formation constants; chelates – EDTA, Chelon Effect, EDTA equilibria, effect of pH on EDTA equilibria, EDTA titration curves, endpoint – detection and indicators; Importance of complexometric titrations.	4
2	SOLVENT EXTRACTION : Distribution law, extraction process, factors effecting extraction, technique for extraction, quantitative treatment of solvent extraction equilibria, and classification of solvent extraction systems. Advantages and applications of solvent extraction.	6
3	CHROMATOGRAPHY: Introduction to chromatography, principles, classification of chromatographic techniques, thin layer and paper chromatography – principle and technique. Column Chromatography – Factors affecting column efficiency and applications. Gas – liquid chromatography – theory, instrumentation and applications. HPLC – instrumentation, method, column efficiency and applications.	8
4	THERMOANALYTICAL METHODS : Principle, classification of methods. TGA –Instrumentation, factors affecting results and analysis of data. Applications. DTG – Instrumentation, analysis of data and applications. DTA – Principle, Instrumentation and applications.	8
5	SPECTROSCOPIC TECHNIQUES: UV Introduction to spectroscopy, Lambert Beer's law, instrumentation and applications ,IR Introduction, basic principles, factors affecting IR group frequencies , Instrumentation and Applications ,NMR Basic principles, elementary ideas and instrumentation chemical shifts, spin-spin coupling.	10
6	ELECTRON MICROSCOPY: Scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Transmission Electron Microcopy (STEM) Principles and Applications	6

Course Outcomes: By the end of this course, the student will be able to:	
1	Address the problems of analyzing complex samples. This would include defining the problem, determining any constraints, choosing the best methodology, and determining how to test the methodology to prove its merits. Where there are alternatives the student should be able to define the advantages and disadvantages of each.
2	Interpret data from analytical separation methods and will understand approaches for the validation of these analytical.
3	Carry out hands on experiments in the field related to analysis of materials required for technological developments and in advanced research in Engineering.
4	Apply various analytical techniques for analysis of organic and inorganic materials.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Principles of Instrumental Analysis”, by Skoog, D. A. & West D. M., 5 th Edition, Saunders College Publishers, USA.	1998
2	“Fundamentals of Analytical Chemistry”, Skoog, D. A. & West D. M., 7 th Edition, Saunders College Publishers, USA.	2000
3	“Industrial Methods of Analysis”, Willard, Merritt, Dean &Settle, 7 th Edition.	1989
4	“Industrial Methods of Chemical Analysis”, Galen W. Ewing, 5 th Edition.	1985
5	“Spectrometric identification of Organic Compounds”, Silverstein R. M. &Webster F.X., 6 th Edition, John Wiley and Sons, Inc., USA	2005
6	“Quantitative Inorganic Analysis”, A.I, Vogel, 5 th Edition.	1989

Course Name	:	ENVIRONMENTAL CHEMISTRY	
Course Code	:	CHN-434	
Credits	:	4	
L T P	:	3 1 0	

Course Objectives:
At the end of this course, the student should be able to understand the basic knowledge of environmental chemistry, such as chemistry of atmosphere, hydrosphere, pedosphere and biosphere. The student will be able to apply basic theories and methods of chemistry to study the environmental issues caused by chemical substances (pollutants).

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	CHEMICAL COMPOSITION OF AIR : Classification of elements, chemical speciation. Particles, ions, and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Sources of trace gases in the atmosphere; Thermo-chemical and photochemical reactions in the atmosphere. Tropospheric oxidation chemistry; Oxygen and ozone chemistry. Chemistry of air pollutants. Role of hydrocarbons; Sulphur chemistry; Halogen Chemistry in the atmosphere.	8
2	WATER CHEMISTRY: Chemistry of water, dissolution / precipitation reactions; complexation reactions; concept of DO, BOD, COD; concept of salinity; composition of sea water and physico-chemical speciation in oceans; Suspended particles; concept of sedimentation, coagulation, filtration,	8
3	SOIL POLLUTION : Pollutants in soil, Agricultural Pollution, Role of Micro nutrients in soil, Ion exchange reaction in soil, Pesticide (Classifications & Degradation), Path of Pesticides in Environment, Monitoring techniques.	8
4	ENVIRONMENTAL TOXICOLOGY AND ITS EVALUATION: Emergence as a science; concepts and definitions; Factors affecting toxicity, Evaluation of LC50, LD50, LCIC and IT.	5
5	TOXIC CHEMICAL IN THE ENVIRONMENT : Metals and other inorganic contaminants; Organic contaminants; Fate of organic contaminants; Pesticides; Biochemical aspects of arsenic, cadmium, lead, mercury, carbon monoxide, ozone and PAN Pesticides; Insecticides, MIC, carcinogens in the air. Photochemistry of Brominated Flame Retardants (BFR) Gene toxicity of toxic chemicals.	8
6	GREEN CHEMISTRY FOR SUSTAINABLE FUTURE : Reagents, Media, Special Importance of Solvents, Water the Greenest Solvents, Synthetic and Processing Pathways, Role of Catalyst, Biological Alternatives, Biopolymers, Principles and Application of Green Chemistry.	5

Course Outcomes: By the end of this course, the student will be able to:	
1	Describe the chemical composition (and the main elements' occurrence forms) of the geosphere, the atmosphere, the hydrosphere, and the biosphere and to explain how interactions between these spheres and the techno sphere affect the environment.
2	Know the basic chemical features of some environmental concerns of today and their societal origin, with specific focus on acidification, eutrophication, ozone, nuclear wastes, heavy metals, organic pollutants, and climate change issues.
3	Develop integrated technologies to support the recycling of carbon and plant nutrients from agricultural crops, bio-based industries and municipal water treatment plants.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“Environmental Chemistry”, Banerji, S.K, 2nd Edition, Prentice-Hall, New Delhi, India.	1999
2	“Environmental Chemistry”, A. K. De, 4 th Edition, New Age International (P) Ltd., New Delhi, India.	2000
3	“Introductory Chemistry for the Environment Science”, Harrison, R. M. and de Mora, S. J. 2 nd Edition, Cambridge University Press, New Delhi.	1996
4	“Introduction to Atmospheric Chemistry”, Hobbes, P.B. Cambridge University Press, UK.	2000
5	“Principles of Environmental Chemistry”, Kothandaaman, H. and Swaminathan, G. B.I. Publications, Chennai, India.	1997
6	“Fundamentals of Environmental Chemistry”, Manahan, S. E. 2nd Edition, CRC Press, Inc., USA.	2001

Course Name	:	RECENT ADVANCES IN CHEMICAL SCIENCES
Course Code	:	CHN-435
Credits	:	4
L T P	:	3 1 0

Course Objectives:	
At the end of this course, the student should be able to use molecular building blocks to design functional supramolecular constructs and nano-structured materials by using the principles of Supramolecular Chemistry. The student will be able to understand chemical and physical phenomena particular to surfaces and interfaces and reduce chemical pollutants flowing to the environment by using principles of Green Chemistry.	

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	SUPRAMOLECULES: Concepts of supramolecular chemistry- Thermodynamics of molecular recognition, solvation, multivalency, Molecular Recognition: Cations, Anions and Neutral guests, Self processes - Self-assembly, Supramolecular -devices and Sensors, Molecular logic, photo switching materials, Supramolecular -material Chemistry Crystal engineering, MOFs and coordination polymers, templates for biomineralisation	8
2	CHEMISTRY OF NANOMATERIALS: Synthesis of nanoparticles by chemical routes and characterization techniques: Thermodynamics and kinetics of nucleation; Growth of polyhedral particles by surface reaction, Ostwald ripening, size distribution; Properties of nanostructured materials : Optical properties; magnetic properties;	9
3	HOMOGENEOUS CATALYSIS : Stoichiometric reaction for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction) oxopalladation reactions, activation of C-H bond.	8
4	SURFACTANT AGGREGATION: Micelles, Surface active agents, Classification of surface active agents, Micellization, Hydrophobic interaction, Critical micellar concentration (cmc), Factors affecting the concentration of surfactants, Counter-ion binding of micelle, Thermodynamics of micellization, Phase separation and Mass action models, Solubilization Emulsions, Mechanism of formation of microemulsion and their stability, Phase maps, Physical techniques, Applications..	9

5	<p>GREEN CHEMICAL PROCESSES: An introduction to the tools of green chemistry and its fundamental principles. Use of Renewable Raw Materials. Evaluating feedstock and starting materials -commodity chemicals from glucose Greener Solvents: The use of supercritical fluids, and aqueous systems Greener reagents and products. Methods of designing safer chemicals Examples of greener reagents replacement of phosgene, methylations using dimethylcarbonate,</p>	8
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Course Outcomes: By the end of this course, the student will be able to:	
1	Exploit supramolecular engineering to design structures with adapted morphologies and properties.
2	Initiate self-assembly processes in bimolecular systems and the basis of bio-inspired chemistry.
3	Understand the interactions between surfaces and gases, liquids or solutions, and how interfaces are important in many technological a biological processes..
4	Identify the new advancements and approaches of chemical sciences for technological leads in various fields of sciences and Engineering.

Suggested Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	“The Organometallic Chemistry of the Transition Metals”, Crabtree, R.G. 4 th Edition, John Wiley.	2005
2	“Wilkinson Advanced Inorganic Chemistry”, Cotton, F.A.; 6 th Edition, John Wiley.	1999
3	“Supramolecular Chemistry”, Steed J. W. and Atwood J. L., John Wiley and Sons, Ltd.	2000
4	“Green Chemistry and Catalysis”, Roger Arthur Sheldon, Dr. Isabel W. C. E. Arends, Dr. Ulf Hanefeld, Wiley-VCH Verlag GmbH & Co. KGaA.	2007
5	“Physical Chemistry of Surfaces”, Adamson A.W., Pubs: John Willey, New York.	1982
6	“Surfactant Science and Technology”, Myers D., Pubs: VCH Publishers.	1988