

## B TECH in INDUSTRIAL AND PRODUCTION ENGINEERING

Year	THIRD SEMESTER							FOURTH SEMESTER						
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C		
II	MAT 2151	Engineering Mathematics – III	2	1	0	3	MAT 2259	Engineering Mathematics – IV	2	1	0	3		
	MME 2156	Facilities Planning and Design	3	0	0	3	MME 2255	Fluid Mechanics and Machinery	3	1	0	4		
	MME 2157	Manufacturing Process Engineering	4	0	0	4	MME 2256	Manufacturing Automation Engineering	3	1	0	4		
	MME 2158	Metrology and Measurements	3	0	0	3	MME 2257	Theory of machines	3	1	0	4		
	MME 2159	Science and Mechanics of materials	3	1	0	4	MME 2258	Work Systems Engineering	3	0	0	3		
	MME 2160	Thermal Engineering	3	1	0	4	**** *****	Open Elective – I				3		
	MME 2173	Computer Aided Mechanical Drawing	0	0	3	1	MME 2274	Metrology Lab	0	0	3	1		
	MME 2174	Material Testing Lab	0	0	3	1	MME 2273	Thermo-fluid lab	0	0	3	1		
MME 2172	Workshop Practice – I	0	0	3	1	MME 2272	Workshop Practice – II	0	0	3	1			
			18	3	9	24		14	4	9	24			
	<b>Total Contact Hours (L + T + P)</b>						30	<b>Total Contact Hours (L + T + P) + OE</b>						27 + 3 = 30
	<b>FIFTH SEMESTER</b>													
III	HUM 3151	Engg Economics and Financial Management	2	1	0	3	HUM 3152	Essentials of Management	2	1	0	3		
	MME 3155	Design of Machine Elements	3	1	0	4	MME 3253	Operations and Supply Chain Management	3	1	0	4		
	MME 3156	Operations Research	3	1	0	4	MME 3254	Tool Engineering and Design	3	1	0	4		
	MME 3157	Simulation Modeling and Analysis	3	0	0	3	MME *****	Program Elective – I	3	0	0	3		
	MME 3158	Total Quality Management	3	1	0	4	MME *****	Program Elective – II	3	0	0	3		
	**** *****	Open Elective – II				3	**** *****	Open Elective – III				3		
	MME 3173	Automation Engineering Lab	0	0	3	1	MME 3273	Operations Management Lab	0	0	3	1		
	MME 3174	Operations Research Lab	0	0	3	1	MME 3274	Quality Engineering Lab	0	0	3	1		
MME 3175	Work Systems Engineering Lab	0	0	3	1	MME 3275	Simulation Modeling and Analysis Lab	0	0	3	1			
			14	4	9	24		14	3	9	23			
	<b>Total Contact Hours (L + T + P) + OE</b>						27 + 3 = 30	<b>Total Contact Hours (L + T + P) + OE</b>						26 + 3 = 29
	<b>SEVENTH SEMESTER</b>													
IV	MME *****	Program Elective – III	3	0	0	3	MME 4298	Industrial Training				1		
	MME *****	Program Elective – IV	3	0	0	3	MME 4299	Project Work/Practice School				12		
	MME *****	Program Elective – V	3	0	0	3	MME 4296	Project Work (Only for B.Tech honour Students)				20		
	MME *****	Program Elective – VI	3	0	0	3								
	MME *****	Program Elective – VII	3	0	0	3								
	**** *****	Open Elective – IV				3								
			15	0	0	18						13		
	<b>Total Contact Hours (L + T + P) + OE</b>						15 + 3 = 18	<b>Total Contact Hours (L + T + P) + OE</b>						

## **Minor Specializations**

### **I. Industrial Management**

MME 4053: Organisational Behaviour  
MME 4054: Personnel Management and Industrial Relations  
MME 4055: Project Management  
MME 4056: Technology Management

### **II. Manufacturing**

MME 4045: Composite Materials  
MME 4046: Heat Treatment of Metals and alloys  
MME 4057: Industrial Robotics  
MME 4047: Lean Manufacturing

### **III. Material Science**

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

### **IV. Business Management**

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

### **V. Computational Mathematics**

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

## **Programme Electives**

MME 4062: Automobile Engineering  
MME 4089: Business Process Re-Engineering  
MME 4065: Corrosion Science and Engineering  
MME 4058: Database Management systems  
MME 4041: Design for Manufacture and Assembly  
MME 4090: Design of Experiments  
MME 4042: Design of Mechanical Systems  
MME 4066: Elements of Mechatronics Systems  
MME 4059: Enterprise Resource Planning  
MME 4060: Ergonomics  
MME 4091: Finite Element Methods  
MME 4072: Machine Tool Technology  
MME 4061: Management Information systems  
MME 4074: Materials Characterization  
MME 4092: Materials Management  
MME 4075: MEMS and Nano Technology  
MME 4076: Micromachining  
MME 4079: Non Destructive Testing  
MME 4078: Non-conventional energy resources  
MME 4082: Plant Engineering and Maintenance  
MME 4093: Rapid Prototyping  
MME 4094: Theory of Metal Forming

## **Open Electives**

MME 4305: Introduction to Operations Research  
MME 4306: Introduction to Quality Control

## THIRD SEMESTER

### **MAT 2151: ENGINEERING MATHEMATICS III [2 1 0 3]**

Gradient, divergence and curl, Line, surface and volume integrals. Green's, divergence and Stoke's theorems. Fourier series of periodic functions. Half range expansions. Harmonic analysis. Fourier integrals. Sine and cosine integrals, Fourier transform, Sine and cosine transforms. Partial differential equation- Basic concepts, solutions of equations involving derivatives with respect to one variable only. solutions by indicated transformations and separation of variables. One-dimensional wave equation, one dimensional heat equation and their solutions. Numerical solutions of boundary valued problems, Laplace and Poisson equations and heat and wave equations by explicit methods.

#### **References:**

1. Erwin Kreyszig: Advanced Engineering Mathematics, (5e), Wiley Eastern, 1985.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, (2e), Prentice Hall, 1990.
3. B.S. Grewal, Higher Engg. Mathematics, edn., Khanna Publishers, 1989.
4. Murray R. Spiegel, Vector Analysis, edn., Schaum Publishing Co., 1959.

### **MME 2156 :FACILITIES PLANNING AND DESIGN [3 0 0 3]**

Introduction to Location, Factors influencing plant location, Qualitative methods of location:- Quantitative methods of location, Plant Layout- Objectives, principles, different type of layouts, Problems on layouts. Material Handling-Scope, Importance and advantages of material handling (MH), principles of material handling, Packaging, types of material handling equipment, Factors Influencing facility design, Planning the layout-Layout fundamentals, scientific approach, line balancing: meaning, Drawings and models, Templates evaluation of layout, installation of layout, Single facility and multi facility location models, warehouse layout models, Design of layout using Travel chart, Sequence demand straight-line method and non - directional method, Conveyor and Storage models, Computer Aided layouts.

#### **References:**

1. James M Apple, Plant Layout and Material handling, (2e), John Wiley, 2003.
2. Francies R.L. and White J.A., Facility layout and Location, (2e), Mc Graw Hill, 1992.
3. Tompkins J A, White, Bozer and Tanchoco, A Facilities planning, (4e), John, 2010.
4. Richard M, Practical Plant Layout, Mc Graw Hill, 1955.
5. SundereshHeragu, Facilities Design, PWS Publishing Company, 2008.

### **MME 2157: MANUFACTURING PROCESS ENGINEERING [4 0 0 4]**

Casting methods. Welding methods. Metal working processes, Forging process, Rolling process, Sheet metal forming operations. Extrusion and Drawing. Lathe features, accessories and attachments. Machining time calculations. Drilling, drill bit nomenclature and computation of drilling time. Milling -Constructional features, attachments, milling operations. Indexing methods and calculations. Grinding methods and accessories. Finishing operations, applications and methods. Non-conventional machining, types and applications. Rapid Prototyping, types and applications.

#### **References:**

1. SeropeKalpakejian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education, 2006.

2. Paul DeGarmo E, Black J T and Ronald A. Kohser, Materials and Process in Manufacturing, John Wiley & Sons, 2004.
3. Lal M. and Khanna O. P., Foundry Technology, Dhanpat Rai and Sons, 1991.
4. Chua C K, Leong K F and Lim C S, Rapid Prototyping: Principles and Applications, World Scientific, 2003.
5. Benedict G. F., Non Traditional Machining Techniques, Marcel Decker, 1990.

### **MME 2158: METROLOGY AND MEASUREMENTS [3 0 0 3]**

Methods of Measurement, Generalized Measurement System and its elements, Static Characteristics of Instruments and measurement systems. Methods of pressure measurement - Elastic pressure elements. Methods of temperature measurement. Types of electrical resistance strain gauges, Theory of operation of wire wound strain gauge, Gauge Factor, Strain gauge bridge circuit, Calibration Circuit, Temperature compensation, Strain measurement on static and rotary shaft, Orientation of strain gauges. Numerical on strain calculation. Measurement of Force & related numerical. Methods of Torque and Shaft power measurement. Types of fits. Taylor's principle for design of gauges, Numerical on design of gauges, Types of gauges. Straightness measurement using Autocollimator. Squareness measurement using Engineer's Square tester and Optical Square. Flatness measurement. Surface roughness types and measurement. Screw thread terminology. Pitch error in threads. Measurement of the elements of the threads – Effective diameter using screw thread micrometer, two wire and three wire methods. Numerical on screw threads.

#### **References:**

1. Beckwith Thomas G., Mechanical Measurements, Pearson Education, 2003.
2. Jain R.K., Engineering Metrology, Khanna Publishers, 1997.
3. Sawhney A.K., Mechanical Measurement & Instrumentation, Dhanpat Rai and Co, 2002.
4. Nakra B.C. and Chaudry K.K., Instrumentation, Measurement & Analysis, Tata McGraw Hill, 2002.
5. Raghavendra N.V. and Krishnamurthy L., Engineering Metrology and Measurements, Oxford University Press, 2013.

### **MME 2159: SCIENCE AND MECHANICS OF MATERIAL [3 1 0 4]**

Crystal structures of materials, packing factor, co-ordination number, Miller indices, crystal imperfections. Degree of super cooling, nucleation, mechanism of solidification. Phases, Gibb's phase rule, solid solutions and types, Intermediate phases, equilibrium diagrams, equilibrium and non-equilibrium cooling, invariant reactions, Lever rule and its application, equilibrium and non-equilibrium cooling of an alloy and congruent melting alloy phase. Iron carbon diagrams, cooling curve for pure iron, Fe-C equilibrium diagrams, study of iron-carbon system in detail with emphasis on the invariant reactions. Tensile, compressive and shear deformation of simple and compound bars under axial load, thermal stress, strain energy, stress strain diagrams for ductile and brittle materials. Shear force and bending moment in cantilever and simply supported beams, stresses in beams, theory of simple bending, shear stresses in beams, evaluation of beam deflection and slope. Torsion of solid and hollow shafts. Principal stresses, Mohr's circle method, analysis of stresses in thick and thin cylinders.

#### **References:**

1. Avner S.H., Introduction to Physical Metallurgy, (3e), McGraw Hill, 2004.
2. William D. Callister, Materials Science and Engineering, John Wiley and Sons, 2007.

- Raghavan V, Material Science and Engineering, (5e), Prentice Hall of India, 2010.
- Beer F. P. and Johnston R, Mechanics of Materials (3e), McGraw-Hill Book Co, 2002.
- Singh D. K., Mechanics of Solids, Pearson Education, 2002.
- Raghavan V., Material Science and Engineering, (4e), Prentice Hall of India, 1989.
- Rajan T. V., Sharma C. P. and Alok Sharma, Heat Treatment Principles and Techniques, Prentice Hall of India, 1999.

#### **MME 2160: THERMAL ENGINEERING [3 1 0 4]**

Introduction, Zeroth Law, heat and work, First law of thermodynamics, Steady flow energy equation, Second law, Carnot cycle, Carnot theorem, Entropy, Clausius inequality, Vapor power cycle-Rankine cycle, Reheat Rankine cycle, Gas power cycles- Otto, Diesel and Dual cycles, Air standard efficiency, Air compressors-Multi-stage and single stage, Intercooling, Elements of Heat transfer - conduction, convection and radiation, Performance testing of IC engines- BP, IP, SFC, Mechanical efficiency, Thermal efficiency, Heat balance sheet.

#### **References:**

- CengelYunus and Bole Michael, Thermodynamics, McGraw Hill, New York, 2010.
- Estop and McConkey, Applied Thermodynamics for Engineering Technologies, Pearson Education, 2002.
- Mayhew A. and Rogers B, Engineering Thermodynamics, E.L.B.S. Longman, 1994.
- Van Wylen. G.J. and Sonntag R.E, Fundamentals of Classical Thermodynamics, John Wiley, 1985.
- Cengel, Thermodynamics and Heat Transfer, McGraw Hills, 1997.

#### **MME 2173: COMPUTER AIDED MECHANICAL DRAWING [0 0 3 1]**

Mechanical Part or Component Drafting using Software includes introduction to Machine Drawing, Conventions, Sectional Views, Screw Thread Terminologies and Thread Forms, Threaded Fasteners, Mechanical Joints and Couplings and 2D Assembled drawing of Mechanical Components. Modelling of Mechanical Part Component using software comprises sketcher exercises, Solid Modelling, Surface Modelling and Assembly Modelling.

#### **References:**

- Gopalkrishna K. R., Machine Drawing, Subhas Publications, 2002.
- Bhat N. D., Machine Drawing, Charotar Publishing House, 2002.
- Venugopal K., Engineering Drawing and Graphics + Auto CAD, New age International Publishers, 2002.
- Sham Tickoo, CATIA for Engineers and Designers, Dreamtech Press, 2005.

#### **MME 2174: MATERIAL TESTING LAB [0 0 3 1]**

To carry out the tension test on mild steel specimen, hardness tests on metals by using Vickers, Brinell and Rockwell hardness testers, impact tests on metals by Charpy and Izod methods, torsion test on mild steel, test on leaf spring, helical spring, bending test and fatigue testing on mild steel, test to find out external flaw using dye penetrant test, understanding the heat treatment processes on steel like annealing, normalizing, hardening and the tempering, microstructure study of metals and estimation of sliding wear properties of a given specimen.

#### **References:**

- Suryanarayana A.V.K., Testing of Metallic Materials, Prentice Hall of India, 1990.
- Khanna and Justo., Highway Materials Testing, Nemchand, 1989.
- Technical Teacher's Training Institute., Laboratory Manual of Strength of Materials, Oxford University Press, 1983.

#### **MME 2172: WORKSHOP PRACTICE – I [0 0 3 1]**

Preparation of models using Welding techniques, Demonstration of Forging and Foundry practice, Lathe and CNC Turning Centre, Acceptance tests on machine tools

#### **References:**

- HajraChaudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy, Elements of Workshop Technology, Vol. I, Media Promoters and Publishers Pvt. Ltd., 2003.
- HajraChaudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy, Elements of Workshop Technology, Vol. II, Media Promoters and Publishers Pvt. Ltd., 2003.
- Peter Smid, CNC Programming Hand book, Industrial Press, 2000.

### **FOURTH SEMESTER**

#### **MAT 2259: ENGINEERING MATHEMATICS IV [2 1 0 3]**

Measures of central tendency, measures of dispersion, mean, median, mode, standard deviation. correlation coefficient Introduction to probability, finite sample space, conditional probability and independence, Bayes' theorem, one dimensional random variable: mean and variance, Chebyshev's inequality. Two and higher dimensional random variables, covariance, correlation coefficient, regression, least square principle of curve fitting. Distributions: binomial, Poisson, uniform, normal, gamma, chi-square and exponential. Moment generating function, Functions of one dimensional and two dimensional random variables, Sampling theory, Central limit theorem and applications.

#### **References:**

- KreyzigE ,Advanced Engineering Mathematics, (7e), Wiley Eastern, 1999.
- Meyer P.L.,Introduction to probability and Statistical applications, (2e), American Publishing Co., 1980.
- Hogg & Craig, Introduction of Mathematical Statistics, (4e), MacMillan, 1975.
- B.S.Grewal, Higher Engg. Mathematics, edn., Khanna Publishers, 1989.

#### **MME 2255: FLUID MECHANICS AND MACHINERY [3 1 0 4]**

Fluid properties, ideal and real fluids, Fluid statics, Pascal's law, Hydrostatic law, pressure measurement by manometers, Total pressure and center of pressure for plane surfaces submerged in liquids, buoyancy, stability conditions for floating and submerged bodies, metacenter and metacentric height, fluid kinematics, continuity equation, Fluid dynamics, Euler's equation, Bernoulli's equation, Linear momentum equation, flow measurement by venturimeter, orifice meter, notches, viscous flow through the circular pipe and between two parallel plates , turbulent flow, major and minor losses, dimensional analysis, similitude, Forces on plane, inclined and curved surfaces. Principle of operation of hydraulic turbines, pumps, gear pump, vane and reciprocating pump.

#### **References:**

- Kumar K. L., Fluid mechanics, Eurasia Publishing House, 2000.
- Jagadish Lal, Hydraulic Machines, Metropolitan Book Company Pvt. Ltd., 1971.

- Bansal R. K., Fluid mechanics and Hydraulic machines, Laxmi Publications (P) Ltd., 2006.
- Kumar D. S., Fluid Mechanics and Fluid Power Engineering, S. K. Kataria Publishers, 2001.
- CengelYunus A. and Cimbala John M., Fluid Mechanics - Fundamentals and Applications, Tata McGraw Hill publications, 2011.

#### **MME 2256: MANUFACTURING AUTOMATION ENGINEERING [3 1 0 4]**

Pneumatic systems, Structure and signal flow of pneumatic systems, Air generation and distribution. Pneumatic actuators, Control valves for direction and flow, Design of manually operated circuits, Control of multiple actuators, Electro pneumatic sensors, Design of electro pneumatic circuits, Hydraulic power pack and accessories, Hydraulic fluids, Filters, Types of hydraulic pumps, actuators, valves, Hydraulic circuits, Computer Numerical Control System, Machine Construction, CNC part programming for Turning Center and Machining Center, Group Technology, FMS and CIM, Computerized Manufacturing Planning Systems.

##### **References:**

- Peter Croser and Frank Ebel, Pneumatics Basic Level TP 101, Festo Didactic GMBH and Co, 2002.
- Prede G. and Scholz D., Electropneumatics Basic Level, Festo Didactic GMBH and Co, 2002.
- Peter Rohner, Industrial Hydraulic Control, John Wiley & Sons, 1989.
- Rao P.N., CAD/CAM, Tata McGraw Hill Publishing Company Ltd., 2005.
- HMT Limited, Mechatronics, Tata McGraw Hill publishing company Ltd., 1998.

#### **MME 2257: THEORY OF MACHINES [3 1 0 4]**

Mechanism and Machine, slider crank and four bar mechanisms, inversions, types of mechanisms. Velocity and acceleration of mechanisms, Relative velocity and instantaneous centre method, Relative acceleration method. Types of Cams and followers, Cam profiles. Balancing of rotating masses in single and different planes. Spur, helical and bevel gear terminology, minimum number of teeth to avoid interference. Types of Gear trains, torque calculations. Belt tensions, power transmitted by a flat and rope belt drive, no. of ropes required. Vibrations- longitudinal, transverse, torsional vibration. displacement, velocity and acceleration, undamped free vibration of spring-mass system.

##### **References:**

- Ballaney P.L., Theory of Machines, Khanna Publishers, 1998.
- Rattan S. S, Theory of Machines, Tata Mc-Graw Hill Publishers Pvt. Ltd, 2009.
- Singh V. P., Theory of Machines, Khanna Publishers, 1998.
- Rao J. S. and Dukkupati R. V., Mechanism and Machine Theory, Wiley Eastern Ltd, 1992.
- Gosh A., and Mallick A. K., Theory of Machines and Mechanisms, Affiliated East West Press, 1989.

#### **MME 2258: WORK SYSTEMS ENGINEERING [3 0 0 3]**

Productivity in the individual enterprise, Total time of a job, Factors tending to reduce productivity, Techniques for reducing excess work content and ineffective time, Basic procedure of Work study, Basic procedure of Method study, Outline process chart, Flow process charts, Flow diagram, The questioning technique, Multiple activity chart, Travel chart, String diagram, The principles of motion economy, Two handed

process chart, Micromotion study, Therbligs, SIMO chart, Work measurement, Time study, Types of elements, Methods of timing the elements, Methods of rating, Standard time determination, Work sampling, Predetermined time standards, Standard Data, Restricted work, Pump diagram, Ergonomics, Anthropometry, Working environment.

##### **References:**

- International Labour Office (ILO), Introduction to work study (3e), Oxford & IBH Publishers, Geneva, 2008.
- Niebel B.W. and Frievalds, A., Methods, Standards, and Work design (12e), McGraw-Hill, 2009.
- Lakhwinder Pal Singh, Work Study and Ergonomics, Cambridge University Press, 2016
- Barnes R.M., Motion and Time study (7e), John Wiley, 2009.
- M S Sanders M.S. and E J McCormick E.J., Human Factors in Engineering Design (7e), McGraw Hill, 1992.

#### **MME 2274: METROLOGY LAB [0 0 3 1]**

Study of measuring instruments and gauges, Screw thread measurements, Measurement of effective diameter of external screw threads, Use of Comparators, Measurement of gear dimensions, Radius and angle measurement, Calibration of Micrometer and Vernier caliper, Surface texture and straightness measurement, Use of Profile projector, Coordinate Measuring Machine and Interferometer.

##### **References:**

- Jain R. K., Engineering Metrology, Khanna Publishers, 1997.
- Gupta I. C., Engineering Metrology, Dhanpat Rai Publications, 1997.
- Raghavendra N. V. and Krishnamurthy L., Engineering Metrology and Measurements, Oxford University Press, 2013.

#### **MME 2273: THERMO-FLUID LAB [0 0 3 1]**

Determination of viscosity, flash & fire point of oil. Performance test on rotary air blower, two stage air compressor, single cylinder four / two stroke petrol and diesel engines. Flow measurement using venturimeter and orifice meter. Calibration of V notch & rectangular notch. Performance test on centrifugal pump, gear pump, impulse turbine and reaction turbine. Measurement of force due to impact of jet on vanes.

##### **References:**

- Ganeshan V., Internal Combustion Engines, (3e), Tata McGraw Hill Education Private Limited, 2007.
- Mathur M. L. and Sharma R. P., Course in Internal Combustion Engines, Dhanpath Rai Publishers, 2001.
- Jagadishlal, Fluid Mechanics and Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd, 1995.
- Bansal R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publication, New Delhi, 2006.

#### **MME 2272: WORKSHOP PRACTICE - II [0 0 3 1]**

Exercises on spur gear and helical gear cutting using milling & gear hobbing machines. Practice of shaping operations, Exercises on grinding operations. Machining using CNC Vertical Machining Center and use of Non-conventional machines.

##### **References:**

- Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy, Elements of Workshop Technology, Vol. II, Media Promoters and Publishers Pvt. Ltd., 2003.
- Peter Smid, CNC Programming Hand book, Industrial Press, 2000.



## FIFTH SEMESTER

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

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

#### Reference Books:

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

### MME 3155: DESIGN OF MACHINE ELEMENTS [3 1 0 4]

Materials and their properties, principal stresses, theories of failure, factor of safety, strength under combined axial, bending & torsional loads, stress concentration. Fatigue: S-N diagram, Low cycle and high cycle fatigue, variables affecting fatigue strength, Goodman & Soderberg equations, stresses due to combined loading. Design of shafts subjected to bending in two planes in addition to axial loads. Stress in keys, Stresses in bolts, Stresses in power screw, Efficiency of power screw, Force & torque requirement to lift load in power screw jack. Helical coil springs, spring materials, Stress & deflection of springs subjected to steady, fluctuating & impact loads, Energy stored in springs, Critical frequency, Concentric springs. Spur and Helical gears design for static, dynamic and wear load. Selection of Journal bearings and Rolling contact bearing.

#### References:

1. Bhandari V. B., Design of Machine Elements (2e), Tata McGraw-Hill Publishing Company Limited, 2007.
2. Norton R. L., Machine Design - An Integrated Approach (2e), Prentice Hall Inc., 2004.
3. Maleev and Hartman, Machine Design (5e) (Revised and edited by Drop Grover), CBS Publishers, 1999.

4. Shigley J. E. and Mischke C. R., Mechanical Engineering Design (5e), McGraw Hill Inc., 2004.
5. Mahadevan K. and Balaveera Reddy K., Machine Design Data Hand Book (4e), CBS Publishers and distributors, 1987.

### MME 3156: OPERATIONS RESEARCH [3 1 0 4]

The subject covers definition, phases, applications, advantages and disadvantages of operations research. Linear programming problems (LPP) are formulated and solved using graphical and simplex methods and Post optimality analysis conducted. The special cases of LPP include Transportation and assignment problems along with travelling salesman problem. Dynamic programming. Game theory and various methods, waiting line models and simulation. Network model analysis using Critical path method and Project evaluation and review technique.

#### Reference Books:

1. Taha H. A., Operations Research (7e), Pearson Education, 2002.
2. Winston W.L., Operations Research, Thomson Asia, 2003.
3. Vohra N. D., Quantitative Techniques in Management, Tata McGraw-Hill Education, 2007.
4. Sharma S. D., Operations Research (14e), KedarNathRamnath Publications, 2005.
5. Kanthiswaroop, Gupta and Manmohan, Operations Research, Sultan Chand and Sons, 2003.

### MME 3157: SIMULATION MODELING AND ANALYSIS [3 0 0 3]

Introduction to Simulation, Advantages and disadvantages, Areas of application, Systems and systems environment, Components of a system, Model of a system, Types of models, Steps in a simulation study, Simulation of Queuing systems, Simulation of Inventory System, Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, Manual simulation using event scheduling, Random Numbers: Properties, Generations methods, Tests for Random number-Frequency test, Runs test, Autocorrelation test, Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique, Input Modelling- Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models. Output Analysis- Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations.

#### References:

1. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete - Event System Simulation (4e), Pearson Education, 2005.
2. Geoffrey Gordon, System Simulation, Pearson India Education Services Pvt Ltd, 2015.
3. Averill M. Law, Simulation Modeling and Analysis (4e), Tata McGraw-Hill, 2008.
4. NarsinghDeo, Systems Simulation with Digital Computer (3e), PHI Publication (EEE), 2004.

### MME 3158: TOTAL QUALITY MANAGEMENT [3 1 0 4]

Definition of quality and Total quality management (TQM), Basic concepts of TQM, Contributions of Gurus of TQM, Characteristics of successful quality leaders, The Deming philosophy, Quality statements, Strategic

planning, Customer satisfaction, Juran Trilogy, PDSA cycle, Kaizen, Supplier partnership, Performance measures, Quality costs, The seven tools of quality control, General quality control engineering fundamentals, Frequency distribution, Inequality theorems, Controlcharts for variables(X, R and s charts) and attributes (p, np, c and u charts), Process capability indexes, Concept of six sigma quality, Acceptance sampling by attributes, Operating characteristic curve, Some aspects of specifications and tolerances, Equipment failure pattern, System reliability, Benchmarking, Quality function deployment (QFD), Failure Mode and Effect Analysis (FMEA), Total Productive Maintenance (TPM), Management tools, Taguchi's quality loss function, Quality and Environmental management systems, Case Studies.

**References:**

1. Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield-Sacre, Hemant Urdhwashe, Rashmi Urdhwashe, Total Quality Management. (3e), Pearson Education, 2012.
2. Mukherjee P.N., Total Quality Management, PHI Learning, 2010.
3. Grant E. L and Levenworth R., Statistical Quality Control, McGraw Hill, 2005.
4. Mahajan M. S., Statistical Quality Control, Dhanpat Rai and Co. Pvt. Ltd., 2012.
5. Oakland John S, Total Quality Management text with Cases, Elsevier, 2006.

**MME 3173: AUTOMATION ENGINEERING LAB [0 0 3 1]**

Pneumatics circuit design using Single acting cylinder, Double acting cylinder, Quick exhaust valve, Shuttle valve, Time delay valve, Dual pressure valve, Pressure sequence valve, Pneumatic Counter, Multiple cylinders, Single solenoid & double solenoid 5/2 valve, Electrical latching, Pressure to electric converter, ON delay timers, Proximity sensors, Electrical counter, Pneumatic circuit using PLC, Hydraulic circuit design using Variable displacement pump, Throttle check valve, Pilot operated check valve, Pressure reducing valve, Pressure switch, Hydraulic Accumulator, 4/3 Direction control valve, Inductive sensor and Hydraulic motor.

**References:**

1. Waller D. and Werener H., Pneumatics Workbook Basic Level, Festo Didactic GMBH & Co. Germany, 1983.
2. Rouff C., Waller D. and Werener H., Electropneumatics Workbook Basic Level, Festo Didactic GMBH & Co. Germany, 1983.
3. Bosch Rexroth AG, Project Manual Industrial Hydraulics, RE 00845/04.07.
4. Rexroth AG, Trainer's Manual Electro Hydraulics, R900071655.

**MME 3174: OPERATIONS RESEARCH LAB [0 0 3 1]**

Formulating and solving real-world problems into a linear problem with suitable assumption, objective functions and constraints using graphical, Simplex method, transportation and assignment method and conducting sensitivity analysis. Solving problems related to game theory, waiting line models, network analysis and dynamic programming. Modeling a linear and non-linear optimization problem and constraints into a simulation model using the Monte Carlo Simulation Technique.

**Reference Books:**

1. Taha H. A., Operations Research (7e), Pearson Education, 2002.
2. Winston W.L., Operations Research, Thomson Asia, 2003.
3. Vohra N. D., Quantitative Techniques in Management, Tata McGraw-Hill Education, 2007.

4. Sharma S. D., Operations Research (14e), Kedar Nath Ramnath Publications, 2005.
5. Kanthiswaroop, Gupta and Manmohan, Operations Research, Sultan Chand and Sons, 2003.

**MME 3175: WORK SYSTEMS ENGINEERING LAB [0 0 3 1]**

Construction of Outline Process Chart, Flow process chart and Flow diagram, Two handed process chart, Multiple activity chart (Man-Machine chart), Performance rating exercises, Basic time determination for the given task, Determination of Standard time using Stop watch time study, Development of Standard data, Determination of Standard time for simple operation using Work study software, Construction of SIMO chart, Estimating Standard time using Predetermine Time Standards (PTS), Measurement of physical work using Walking simulator and Ergometer.

**References:**

1. International Labour Office (ILO), Introduction to work study (3e), Oxford & IBH Publishers, 2008.
2. Niebel B.W. and Frievalds, A., Methods, Standards, and Work design (12e), McGraw-Hill, 2009.
3. Lakhwinder Pal Singh, Work Study and Ergonomics, Cambridge University Press, 2016.
4. Barnes R.M., Motion and Time study, John Wiley (7e), 2009.
5. Sanders M.S. and McCormic E.J., Human Factors in Engineering Design (7e), Edition, McGraw Hill, 1992.

**SIXTH SEMESTER**

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

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

**References:**

1. Harold Koontz and Heinz Weihrich, Essentials of Management, McGraw Hill, 2012.
2. Peter Drucker, Management: Tasks, Responsibilities and Practices, Harper and Row, 1993.
3. Peter Drucker, The Practice of Management, Harper and Row, 2004.

**MME 3253: OPERATIONS AND SUPPLY CHAIN MANAGEMENT [3 1 0 4]**

Introduction to operations supply chain management, Types of production systems, Production consumption cycle, Functions of production and operations management. supply chain decisions, types of supply chains, supply chain metrics, logistics, bullwhip effect,

Forecasting, Qualitative methods of forecasting, Quantitative methods of forecasting, Forecast control, Pure and mixed strategies of aggregate planning, Aggregate planning using trial and error approach, Materials Requirement planning, Job shop scheduling Factors affecting job shop scheduling, Index method, Priority sequencing rules, Classification of inventories, Economic order quantity, Inventory control models, The role of facility decisions in supply chain, factors influencing network design in supply chain, Role of transportation in a supply chain, factors affecting transportation decisions, modes of transportation and their performance characteristics, Routing and scheduling in transportation, The impact of financial factors on supply chain decisions.

**References:**

1. Monks Joseph G., Operations Management, Tata McGraw-Hill Publishing Co. Ltd., 2004.
2. Krajewski Lee J. and Ritzman Larry P., Operations Management, Pearson Education Pte. Ltd., 2005.
3. Sunil Chopra and Peter Meindi, Supply chain management, Pearson Education, 2001.
4. Russell and Taylor, Operations management Along with supply chain, Wiley India Edition, 2011.
5. G.Srinivasan, Qunatitative Models in Operations and supply chain management, PHI,2010.

**MME 3254: TOOL ENGINEERING AND DESIGN [3 1 0 4]**

Introduction to tool engineering and design, Nomenclature of single point and few multi point cutting tools. Theory of metal cutting, Tool life and wear. Merchant's analysis, Taylor's equation and factors affecting tool life. Design of single point cutting tools. Design of form tools. Design of drill, Milling cutters and Broaches. Elements of jigs and fixtures and design procedure. Different type of work holding devices and Clamping devices. Design of drill jigs. Design of milling fixtures. Press tool design. Design of different types of dies and punch. Die materials and method of punch support. Design of elements of press tools, strip layout, centre of pressure. Design of Forming and Drawing dies.

**References:**

1. ASME hand book, Fundamentals of tool design, Society of Manufacturing Engineers, 1991.
2. Juneja B. L. and Sekhon G. S., Fundamentals of Metal cutting and Machine Tools, New Age International (P) Ltd., 1995.
3. Shaw M. C., Metal cutting principles, Clarendon Press, Oxford, 1996.
4. Nagpal G. R, Tool Engineering & Design, Khanna Publishers, 2008.
5. Joshi P.H., Jigs and Fixture, Wheeler Publishing, 1996.

**MME 3273: OPERATIONS MANAGEMENT LAB [0 0 3 1]**

Purchasing decisions in supply chain: Generating Bill of Materials, Creating Item Master for various Engineering Designs, Conduction of vendor Evaluation/Rating exercise, Creating Purchase order for Items, Creating Work order for Items, Perform inventory transaction, Creating quotation process for Items, Creating Dispatch Instruction for Items, Production planning decisions, Production Control Decisions, Inventory management in supply chain, Facility Decisions in Supply chain, Transportation Decisions in a supply chain, Financial evaluation of supply chain Decisions.

**References:**

1. Monks J.G, Operations Management, McGraw-Hill International, Editions, 1987.
2. Pannerselvam. R, Production and Operations Management (2e), PHI,. 2005.

3. Buffa, Modern Production/Operations Management (4e),Wiley India Ltd., 2007.
4. Chary S.N, Production and Operations Management (3e), Tata-McGraw Hill, 2009.

**MME 3274: QUALITY ENGINEERING LAB [0 0 3 1]**

To test the Goodness of fit for the given quality characteristic using Binomial, Poisson Uniform and Normal distributions, Conduction of Repeatability and Reproducibility studies for the given measurement system, Construction of control charts for variables (X, R and s charts) and attributes ( p, np, c and u charts), Assessing the Process capability of the given manufacturing process, Construction of Operating characteristic curve for the given acceptance sampling plan, Graphical and pictorial representation of data, Construction of control charts for variables and attributes using statistical software.

**References:**

1. Grant E. L and Levenworth R., Statistical Quality Control, McGraw Hill Publications, 2005.
2. Montgomery D.C., Introduction to Statistical Quality Control, John Wielej and Sons, 2005.
3. Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield-Sacre, Hemant Urdhwarshe, Rashmi Urdhwarshe, Total Quality Management. (3e), Pearson Education, 2012.
4. Mahajan M.S., Statistical Quality Control, Dhanpat Rai and Co. Pvt. Ltd., 2012.
5. Juran J.M. and Gryna F.M., Quality Planning and Analysis, Tata McGraw Hill Publications, 1995.

**MME 3275: SIMULATION MODELING AND ANALYSIS LAB [0 0 3 1]**

Introduction to Simulation Packages and selection, Identifying probability distributions for given data, Building simulation models for manufacturing operations and service operations, Statistical Analysis of Simulation models (input and output analysis).

**References:**

1. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete - Event System Simulation (4e), Pearson Education,2005.
2. Geoffrey Gordon, System Simulation, Pearson India Education Services Pvt Ltd, 2015.
3. Averill M. Law, Simulation Modeling and Analysis (4e), Tata McGraw-Hill, 2008.
4. NarsinghDeo, Systems Simulation with Digital Computer (3e), PHI Publication (EEE), 2004.

**SEVENTH SEMESTER**

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

**EIGHTH SEMESTER**

**MME 4298: INDUSTRIAL TRAINING**

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



### **MME 4299: PROJECT WORK/PRACTICE SCHOOL**

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

### **PROGRAM ELECTIVES**

#### **MME 4053: ORGANIZATIONAL BEHAVIOR [3 0 0 3]**

Contributing disciplines to OB, Basic OB Model. Learning, Methods of shaping behavior, Values, Attitudes and Job satisfaction, Personality, Determinants of Personality, Personality theories, Major personality attributes, Perception Attribution Theory, Selective perception, Halo effect, Contrast effect, Stereo-typing. Maslow's hierarchy of needs, Theory X and Theory Y, Frederick Herzberg's Motivation and Hygiene Theory, Contemporary Theories, Group Dynamics, Group Behaviour Model, Quality of a good leader, types and theories of leadership. Conflict, Dimensions of Conflict Handling Intentions, Virtual Organisation, Boundary less Organisation, Mechanistic and Organic Model, Factors influencing organisation structure. Work Design, Organisational Change and Organisational Development, Lewin's Three-Step Model and Action research. Organisational Development.

#### **References:**

1. Luthans Fred, Organisational Behaviour, McGraw Hill, 2010.
2. Davis Keith and Newstrom J.W., Organisational Behaviour at Work, Tata-McGraw Hill, 2009.
3. Greenberg Jerald and Baron Robert A., Behaviour In Organisations: Understanding and Managing the Human Side of Work, Prentice Hall of India, 2010.
4. Uma Sekaran., Organisational Behaviour: Text & Cases, McGraw Hill Education, 2004.
5. Robbins, Stephen P., Organizational Behaviour, Prentice-Hall of India Pvt. Ltd., 2003.

#### **MME 4054: PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS [3 0 0 3]**

Objectives of personnel management, Functions of Personnel Management, Process of Human Resource Planning, Steps in recruitment process, Sources of recruitment, methods of recruitment. Promotions, Demotions, Transfers, Separation, Absenteeism and Turn over, Wage and Salary administration, Performance Appraisal, Methods of Performance evaluation. Industrial Relations, Functional Requirements, Employees participation in management. Grievances and Grievance Handling, Act of Indiscipline/ Misconduct, Principles for maintenance of discipline. Industrial Disputes, Procedure for the Settlement of Disputes, Government and Industrial Relations, Organs of Industrial Peace, Trade Unions, Objectives and Functions, Growth of Trade Union Movement, Factors Affecting Growth of Trade Unions, Essentials of a Successful Trade Union.

#### **References:**

1. Mamoria C B and Gankar S V, Personnel Management, (23e), Himalaya Publishing House, 2003.
2. Megginson L C, Personnel and Human Resources Administration,

(3e), R. D. Irwin, 1977.

3. Beach D S, Personnel: The Management of the People at Work, (3e), Macmillan, 1975.
4. Yoder D, Handbook of Personnel Management and Labor Relations, Volume 1, McGraw Hill, 1958.

#### **MME 4055: PROJECT MANAGEMENT [3 0 0 3]**

Concept of project, Project life cycle, organizing projects within the functional organization, organizing projects as dedicated teams, organizing projects within a matrix arrangement, Project manager and their attributes. Feasibility study, Pre-feasibility study, Steps of feasibility study. Estimating project times and costs, Factors influencing the quality of estimates, Top-down approaches of estimation, Bottom-up approaches of estimation, Hybrid approach of estimation. Risk management process, Risk Assessment - probability analysis, Contingency planning, Contingency funding and time buffers, Risk response control, Project scheduling, Bar charts and Milestone charts, Development of networks, Work Breakdown Structure, Program Evaluation and Review Technique, Project audit and closure, Audit reporting, Evaluation of project team and members.

#### **References:**

1. Gray C., Larson E. and Desai G., Project Management - The Managerial Process, Tata McGraw Hill Pvt. Ltd., 2013.
2. Paneer Selvam R. and Senthil Kumar P., Project Management, PHI Learning Pvt. Ltd., 2010.
3. Chandra P., Projects - Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill Pvt. Ltd., 2009.
4. Choudhry S., Project Management, Tata McGraw Hill Publishing Co. Ltd., 1997.
5. Punmia B. and Khandelwal K., Project Planning and Control with PERT and CPM, Laxmi Publications Pvt. Ltd., 2006.

#### **MME 4056: TECHNOLOGY MANAGEMENT [3 0 0 3]**

Management of technology, integrated and holistic model, Innovation and Competition, Timing and innovation, technology and competition, Entrepreneurs and innovation, role of the entrepreneurs, new ventures in corporation, High tech new ventures, the business plan, using the business plan to achieve goals, a business plan that sells, successful product innovation, sources of venture capital. Dynamics of new firms, corporate systems, The science base of the innovation process, Micro level -the corporate innovation process, Form of technology change, the linear portion of the technology S-curve, mature and obsolete industries, innovation and market saturation, managing technology life cycles, economic long cycles, Kondratieff waves, the long wave process, the long wave hypothesis. Sources of innovation, market pull and technology push, technology maps, marketing flexibility, market positioning, sources of radical innovation, marketing experimentation in new technology. Project strategy, R&D projects.

#### **References:**

1. Betz Frederick, Managing Technology, John Wiley and Sons, 2011.
2. Narayanan V. K., Managing Technology and Innovation for Competitive Advantage, Prentice Hall, 2001.
3. Duening, Hisrich and Lechter, Technology entrepreneurship, Academic Press, 2014.
4. Richard and Thomas, Technology Ventures-from idea to enterprise, McGraw Hill, 2004.
5. Szakonyi Robert, Technology Management, Auerbach Publications, 2001.

### **MME 4045: COMPOSITE MATERIALS [3 0 0 3]**

Definition, Classification, Types of matrices & reinforcements, Characteristics & selection, Fiber composites, Laminated composites, Particulate composites, Prepregs, Sandwich construction. Glass, Carbon and Advanced fiber manufacturing methods, Applications, Advantages, Disadvantages and Properties. Micro mechanical analysis of a lamina: Introduction, Derivation of stress, Strain, Modulus of elasticity of fiber reinforced composites. Rule of mixture, Problems to find density, Mechanical properties of composites by using Rule of mixture. Processing of polymer composites: Description of method, Advantages, Disadvantages and Application, Hand-layup, Spray-layup, Compression molding Injection molding, Reaction injection molding, Autoclaving, Resin transfer molding, Filament winding, Pultrusion. Sheet molding, Pre-pegging and challenges in primary processing of composites. Secondary processing of polymer composites: Joining of polymer composites, Adhesive joining, Mechanical joining, Microwave joining, Induction and resistance welding, Drilling of polymer composites, Conventional vs ultrasonic drilling, Remedies for reducing drilling induce damages, Research tools for secondary processing. Testing of polymer composites: ASTM standards and procedures, test for physical properties, mechanical properties Viz., tensile, flexural, impact etc., SEM analysis, case studies. Application developments: Aircrafts, Missiles, Space, Automobile, Electrical and electronics, Marine, Recreational and sports equipment's, Construction. Potential future applications of composites.

#### **References:**

1. Mein Schwartz, Composite Materials Handbook, McGraw Hill Publication, 1984.
2. Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 2005.
3. Krishan K. Chawla, Composite Material Science and Engineering, Springer Publication, 1987.
4. Mallik P. C., Fiber Reinforced Composites, Marcel Decker Publication, 1993.
5. Rober M. Jones, Mechanics of Composite Materials, McGraw Hill Kogakusha Ltd, 2008.

### **MME 4046: HEAT TREATMENT OF METALS AND ALLOYS [3 0 0 3]**

Iron-Carbon equilibrium diagram, Lever rule, isothermal transformation diagram, heat treatment of steels, phase transformations. Heat treatment processes, annealing, normalising, hardening, tempering, hardenability, determination of hardenability - Grossman's critical diameter method, Jominy end quench test, Factors affecting hardenability. Carburizing, post carburizing treatments, cyaniding and carbonitriding, nitriding, plasma nitriding, boronizing & chromizing, flame hardening, induction hardening, electron beam hardening, laser hardening. Controlled rolling, ausforming, isoforming, marstraining, cryoforming, thermomechanical annealing, thermomechanical treatment of non-ferrous alloys. Steel specification, classification and heat treatment of steels and cast iron. Heat treatment and application of aluminium alloys, titanium alloys, copper alloys, defects, causes and remedies in heat treatment.

#### **References:**

1. Rajan T. V., Sharma C.P and Alok Sharma, Heat treatment principles and techniques, PHI Publication, 1999.
2. Bolton W., Engineering materials technology, Heinmann Newness, 2001.
3. Thelning K. E., Steel and its heat treatment, Butterworth/Heinemann, 2000.
4. Romesh C. Sharma, Principles of Heat Treatment of Steels, New Age International (P) Limited, 1996.
5. Vijendra Singh, Heat Treatment of Metals, Standard Publishers Distributors, 2012.

### **MME 4057: INDUSTRIAL ROBOTICS [3 0 0 3]**

Definition of robots, Automation and Robotics, Robot configuration, Robot Motions, Work Volume, Drive System, Control System, Precision of movement, Specification of a robot, Applications of industrial robots, Robot Motion Analysis, Forward and reverse transformation of 2 degree of freedom arm, Arm manipulation for 3 degree of freedom arm, Homogeneous transformations and robot kinematics, Robot Dynamics, Robot end effectors, Force analysis of gripper, Physical support of the end effectors, Guidelines for gripper selection, Sensing systems, Types and features of robot sensors, Machine vision, Robot Control Systems, Mathematical models, Types of controllers, Robot drive system, , Robot programming languages.

#### **References:**

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nichoas G Odrey and Ashish Dutta, Industrial Robotics (2e), McGraw Hill Education (India) Pvt. Ltd, 2012.
2. Yoram Koren, Robotics, McGraw Hill, 1992.
3. Groover M.P, Cam and Automation, Prentice Hall, 1995.
4. Yu Kozyhev, Industrial Robots Handbook, MIR Publications. 1985.
5. Fu, Gonzalez and Lee, Robotics: Control Sensing, Vision and Intelligence, Tata McGraw Hill. 2008.

### **MME 4047: LEAN MANUFACTURING [3 0 0 3]**

The lean production system, lean revolution in Toyota, basic elements of lean manufacturing, principles and characteristics of lean manufacturing, MUDA and types. Value stream mapping Material and information flow, Selection of the product family, Value stream manager, Using the mapping tool, Drawing the current state map, Characteristics of lean value stream, Drawing the future state map, Achieving the future state. Introduction to Kanban: Data collection, case studies. Kanban Size: Determining the replenishment cycle, Implication of scrap, unplanned downtime and changeover time on replenishment intervals, buffer calculations, Calculation of number of containers, Reality check, Alternate method of kanban sizing, supplier kanban, Finished goods kanban, Production smoothing: Smoothing of total production quantity - Demand fluctuation and production capacity plan, Shortening production lead time: Components of production lead time, shortening processing time through single production and conveyance, Multifunction workers, shortening processing time through small sized lot production, shortening waiting time and conveyance time. Shortening setup time - concepts and techniques: Setup concepts, Concept applications, Analyzing setup actions, Procedure for setup improvements. Standardization of operations: Components of standard operations, Determining the cycle time, Determining the completion time per unit, determining the standard operation routine, Yoi-don system, One shot setup, Determining the standard quantity of work in progress, Preparing the standard operation sheet.

#### **References:**

1. Monden Y., Toyota Production System: An Integrated Approach to Just-In-Time (4e), CRC Press, U.S.A, 2011.
2. Rother and Shook, Learning to See: Value Stream Mapping to add Value and Eliminate Muda, The Lean Enterprise Institute, U.S.A., 1999.
3. Gross and McInnis, Kanban Made Simple: Demystifying and Applying Toyota's Legendary Manufacturing Process, AMACOM Books, U.S.A., 2003.
4. Fled W., Lean Manufacturing: Tools, Techniques and How to Use Them, CRC Press, U.S.A., 2001.
5. Dailey K. W., The Lean Manufacturing Pocket Handbook, D.W. Publishing Co., 2003.

### **MME 4062: AUTOMOBILE ENGINEERING [3 0 0 3]**

Automotive engine parts, Spark Ignition (SI) & Compression Ignition (CI) engines, Multi-cylinder arrangements. Cooling requirements & methods. Various lubrication arrangements. Fuel pumps for petrol and diesel engines, Types of carburetors. Fuel injector and Multi-Point Fuel Injection system. Various ignition systems and ignition advance methods. Bendix drive. Clutches- purpose and requirements, Various types of clutches. Various types of Gearboxes. Drive configuration and parts of drive system, types of rear axle arrangements. Tyreproperties, tubed tubeless tyres. Steering geometry, Steering mechanisms and linkage systems. Requirements and Types of suspensions, Telescopic shock absorber. Braking requirements, Brake efficiency and stopping distance, Various Types of brakes, Balance beam compensator, Antilock braking system. Automotive emission control system, Method to control various emissions, Emission standards- Euro and Bharat norms. Modern Vehicles, Construction and operational features of four wheelers available in Indian market, Introduction to electric vehicles & hybrid vehicles.

#### **References:**

1. Heinz Heisler, Vehicle and Engine Technology (2e), Butterworth-Heinemann Publication, 1998.
2. Kirpal Singh, Automobile Engineering Vol. I & II (13e), Standard Publishers Distributors, 2017.
3. R.K. Rajput, Automobile Engineering (2e), Laxmi Publication (P) Ltd, 2017.
4. K. K. Jain, R. B. Asthana, Automobile Engineering (1e), Tata McGraw Hill Education, 2017
5. Narang G. B. S., Automobile Engineering(5e), Khanna Publishers, 1995.

### **MME 4089: BUSINESS PROCESS RE-ENGINEERING [3 0 0 3]**

Introduction to business processes, common business process in organisations, role of leader and manager, breakthrough reengineering, BPR and performance improvement, key targets of BPR, business process redesign & improvement, Just-in-time, collaborative manufacturing, intelligence manufacturing, product planning, product design and development, Introduction to BPR, History of BPR, BPR in manufacturing industry, Benefits of BPR, BPR and information technology, BPR implementation methodology, success factors of BPR, barriers of BPR, frame work for barrier management, BPR and relevant technologies.

#### **References:**

1. Radhakrishnan R and Balasubramanian S, Business process Re-engineering: Text and Cases (1e), PHI Learning Private Limited, 2008
2. Jayaraman M S, Natarajan G and Rangaramanujan A V, Business Process Reengineering, Tata McGraw Hill Education, 2007
3. Sethi V and King W R, Organizational Transformation through Business Process Reengineering, Pearson Education India, 2003
4. Grover V, Markus M L, Business Process Transformation, PHI Learning Pvt. Limited, 2010.

### **MME 4065: CORROSION SCIENCE AND ENGINEERING [3 0 0 3]**

Introduction: Definitions, Technological importance of corrosion study, Corrosion as useful process, Corrosive environments, Consequences of corrosion, Factors affecting corrosion, Economical aspects of corrosion, Corrosion science and corrosion engineering. Fundamental aspects of corrosion: Cell analogy, electrode potential, emf and galvanic series - their uses in corrosion studies, Corrosion cell, Cathodic and anodic reactions, Types of corrosion cells, Reference electrode and their

types, Pourbaix diagram for metal-water system. Principles of corrosion: Corrosion rate expressions and calculations, Nernst's Equation, Electrochemical nature of aqueous corrosion, Faradays' laws of electrolysis, Current density, Factors influencing corrosion rate. Types of corrosion: Characteristic features, causes and remedial measures of different forms of corrosion: Dry & wet corrosion, Uniform, Galvanic, Crevice, Pitting, Crevice, Erosion, Intergranular, Selective leaching, Stress corrosion cracking, Hydrogen damage, Liquid metal attack, Hydrogen embrittlement, Atmospheric corrosion - classification and factors influencing atmospheric corrosion, Introduction to high temperature corrosion, Prevention of high temperature corrosion, Corrosion/ Chemical degradation of non-metallic materials like rubbers, plastics and ceramics. Polarization: Thermodynamics and Kinetics of Electrode Processes- Polarization Curves, Over-Potential, Passivity, Transpassivity, Measuring polarization, Anodic polarization, Cathodic polarization, Activation Polarization and Concentration polarization. Corrosion control: Principles of corrosion prevention, Material selection, Design considerations, Control of environment including Inhibitors and Passivators, Coatings - metallic, inorganic, organic, Electroplating of copper, Nickel and Chromium, Electro-less plating, Anodising, Galvanizing, Thermal spraying, Alloy plating, Cathodic and anodic protection, Chemical and electrochemical polishing, Phosphating, Chromating, Chemical colouring. Corrosion Monitoring: Laboratory corrosion tests, Accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by Gravimetric, Tafel polarization, Linear polarization, Cyclic polarization, Impedance spectroscopy, NDT techniques - Ultrasonic, Radiography and Eddy current.

#### **References:**

1. Mars G. Fontana, Corrosion Engineering(3e), Tata McGraw Hill, 2008.
2. Zaki Ahmed, Principles of Corrosion Engineering and Corrosion Control, Elsevier Science and Technology Books, 2006.
3. Trethewey K. R. and Chamberlain Longman J., Corrosion for students of Science and Engineering, Scientific & Technical, USA, 1988.
4. Philip A Schweitzer, Fundamentals of corrosion-Mechanisms, Causes and Preventive methods, CRC Press, Taylor and Francis Group, 2010.
5. Uhlig H.H. and Revie R. W., Corrosion and Corrosion Control, Wiley, 1985.

### **MME 4058: DATABASE MANAGEMENT SYSTEMS [3 0 0 3]**

Definition of database and its characteristics, users of database, advantages and implications of database approach, Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management systems, Benefits of data modelling, Types of database models, Phases of database modelling, The entity-relationship model, Entity types, entity sets, attributes, and keys, relationships, relationship types, roles, and structural constraints, weak entity types, ER diagrams and design issues, relational model concepts, constraints, and schemas, update operation on relations, basic and additional relational algebra operations, and queries in relational algebra, structured Query Language (SQL): data definition etc. in SQL2, basic and complex queries in SQL, insert, delete, update statements, and views in SQL, embedded SQL, secondary storage devices, buffering of blocks, placing file records on disk, operations on files, heap files and sorted files, hashing techniques, primary, secondary and multilevel ordered indices, dynamic multi-level indices using B-trees and B+ trees, design guidelines for relational schemas, functional



Dependencies, normalization - 1st, 2nd, 3rd, 4th and 5th normal forms, importance of normalization, limitations of normal forms.

**References:**

1. ElmasriRamez and NavatheShamkanth B., Fundamentals of database Systems (3e), Addison Wesley Publishing Company, 2011.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management System (3e), Tata McGraw Hill, 2010.
3. McFadden, Hoffer J Prescott, Modern Data base management, Pearson, 2007.
4. Hansen Gary W and Hansen James V., Database Management and Design (2e), PHI Pvt. Ltd, 2002.
5. Das Gupta and Radha Krishna, Database Management system Oracle, SQL and PL/SQL (2e), 2013.

**MME 4041: DESIGN FOR MANUFACTURE AND ASSEMBLY [3 0 0 3]**

Morphology of design, different phases, overview of product design, advantages of using DFMA, principles of DFMA in mechanical design, selection of materials and processes. Design guidelines for sand casting, investment casting, metal extrusion, stamping, fine blanked parts, rolled formed section, forging process, machining processes, heat treatment, die casting, injection moulding, sheet metal process, powder metallurgy process, joining processes. Advantages and disadvantages of 3D printing, design guidelines for 3D printing and different assembly techniques, importance of fits, tolerance and surface finish in design, production drawings.

**References:**

1. Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, Product Design for Manufacture and Assembly, CRC Press, 2011.
2. James G. Brala, Design for Manufacturability Handbook, McGraw Hill, 1999.
3. Kevin Otto and Kristin Wood, Product Design Pearson Education, 2001.
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall of India Pvt. Ltd., 2005.
5. George E. Dieter, Engineering Design, McGraw Hill Book Co. 2000.

**MME 4090: DESIGN OF EXPERIMENTS [3 0 0 3]**

Strategy of experimentation, Applications, Basic principles, Terminology, Guidelines, Tools used in robust design, Applications and benefits, Quality loss function, Quadratic loss function, Noise factors, P diagram, Optimization of product and process design, Role of various quality control activities. Factorial Experimentation, Blocking and Confounding in the 2k Factorial Design, Fractional Factorial Designs, Constructing Orthogonal Arrays, Steps in Robust Design, Evaluation of sensitivity to noise, Signal-to-Noise ratios for static and dynamic problems. Analysis of ordered categorical data, Minimizing variability and optimizing averages, Taguchi Inner and Outer Arrays, Software packages for design of Experiments.

**Reference Books:**

1. D.C. Montgomery, Design and Analysis of Experiments (5e), Wiley India, 2006.
2. Madhav S. Phadke, Quality Engineering Using Robust Design, Prentice Hall PTR, 1989.
3. Robert H. Lochner, Joseph E. Matar, Designing for Quality - An Introduction Best of
4. Taghuchi and Western Methods or Statistical Experimental Design, Chapman and Hall, 1990.

5. Philip J. Ross, Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design (2e), McGraw-Hill, 1996.

**MME 4042: DESIGN OF MECHANICAL SYSTEMS [3 0 0 3]**

Introduction to Mechanical design process, Design factors. Design of Piston, Connecting rod, Crankshaft-Overhung & Center type, Valve gear mechanism. Flange coupling, Screw jack, Single plate clutch, Two speed gear box, Passenger lift, Concrete mixer, Automobile chassis & suspension. Optimization in design -Johnson's method of optimization-bar, spring, shaft.

**References:**

1. Bhandari V.B., Design of Machine Elements(3e), Tata McGraw Hill Publishing Company, 2010.
2. Trikha S. N., Machine Design Exercises, Khanna Publishers, 2001.
3. Patil S. P., Mechanical System Design, Jaico Publishing House, 2004.
4. George E. Dieter, Engineering Design , McGraw Hill Book Co., 2000.
5. Karl T. Ulrich & Steven D. Eppinger, Product Design and Development, Irwin McGraw Hill, Boston, 2003.

**MME 4066: ELEMENTS OF MECHATRONICS SYSTEMS [3 0 0 3]**

Introduction: Definition, basic concepts and elements of mechatronic systems, needs and benefits of mechatronics in manufacturing, Sensors, Transducers: Displacement. Piezoelectric actuators, Shape memory alloys. Hydraulic & Pneumatic devices - Power supplies, valves, cylinder sequencing. Data acquisition and translation: Signal conditioning - Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, Multiplexer, Pulse width Modulation Counters, decoders, ADC, DAC Signal Analysis - Linearization of data, Compensation, Signal Averaging, Fourier analysis. Data presentation system: Display - Cathode ray oscilloscope, LED, LCD, Printers, Magnetic Recording, Controllers and Algorithms: Microprocessor Applications.

**References:**

1. Alciatore David G & Histan Michael B, Introduction to Mechatronics and Measurement systems, Tata McGraw Hill, 2003.
2. Boltan W, Mechatronics, Addison Wesley Longman Ltd, 1999.
3. Devdas Shetty & Richard Kolk, Mechatronics System Design, PWS Publishing, 2001
4. Dan Nesculescu, Mechatronics, Pearson Education Pvt. Ltd, 2002.
5. Bradley D A and others, Mechatronics, Nelson Thornes Chennai, 2004.

**MME 4059: ENTERPRISE RESOURCE PLANNING [3 0 0 3]**

Introduction to ERR ERP and related technologies, integrated management information, business modelling, integrated data model. Executive information system, data warehousing, data mining, online analytical processing, A manufacturing perspective of ERR CAD/CAM, Materials requirement planning, bill of materials, closed loop MRR Manufacturing resource planning, distribution requirements planning, ERP modules, Benefits of ERR ERP implementation life cycle, implementation team training, testing, end user training, Vendors, consultants and users, Future directions in ERR faster implementation methodologies, business models, ERP case studies.

**References:**

1. Alexis Leon, Enterprise Resource Planning (2e), Tata McGraw Hill Education, 2008.
2. Monk E and Wagner B, Concepts in Enterprise Resource Planning (4e), Cengage Learning, 2012.



- Garg V K and Venkatakrishnan N K, Enterprise Resource Planning: Concepts and Practice (2e), PHI Learning Pvt. Limited., 2003.
- Jaiswal M and Vanapalli G, Textbook of Enterprise Resource Planning, Macmillan, 2005.

#### **MME 4060: ERGONOMICS [3 0 0 3]**

Definitions of Ergonomics, Role of human factors engineer, Types of systems, Elements of man-machine system, System approach to human engineering, Information input and processing, Information theory, Sources and pathways of stimuli, Human sensorimotor system, Biases in decision making. Visual Displays, Quantitative and qualitative displays, Auditory displays, Biomechanics of motion, Functions of controls, Factors influencing design of control, Design of hand and foot controls, Use of Anthropometric data, Work surface, Location of component and general work place arrangement, Industrial fatigue, Causes and elimination of fatigue, Productivity and its improvement, Worker and working environment, Effect of light, colour, noise and vibration on performance.

#### **References:**

- Mark S. Sanders and Ernest J McCormick, Human Factors in Engineering and Design (7e), McGraw-Hill and Co, 1992.
- Bridger R.S., Introduction to Ergonomics, Taylor & Francis (3e), 2008.
- Pulat B. Mustafa, Fundamentals of Industrial Ergonomics (2e), Waveland Press Inc, 1997.
- Khan M. I., Industrial Ergonomics, PHI Learning Pvt. Ltd., 2010.
- Gavriel. Salvendy, Handbook of Human Factors and Ergonomics (3e), Wiley, 2006.

#### **MME 4091: FINITE ELEMENT METHODS [3 0 0 3]**

Review of matrix algebra, Eigen value problem, Gauss quadrature integration, Displacement and potential energy of a 3D Elastic Body, Minimum potential energy principle, Rayleigh-Ritz and Galerkin's methods, definitions and terminologies in finite element method (FEM), displacement polynomial function, Pascal's triangle, Shape functions for linear and higher order quadrilateral (Lagrange and Serendipity) and triangular elements; finite element formulation of 1D (bar element) structural problem by direct stiffness method and Galerkin's approach, Elimination and Penalty methods of handling boundary conditions; finite element formulation of 1D (bar, truss and beam elements), 2D (triangular, quadrilateral elements) and 3D (tetrahedral and hexahedral elements) structural problems by isoparametric approach.

#### **References:**

- Chandrupatla T. R. and Belegundu A. D, Introduction to Finite Elements in Engineering, Pearson Education, 2001.
- Daryl L. Logan, A First course in Finite Element Method (4e), Thompson Ltd., India, 2007.
- David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill, India, 2005.
- J. N. Reddy, An Introduction to Finite Element Method (3e), McGraw Hill International Edition, 2006.
- Larry J. Segerlind, Applied Finite Element Analysis (2e), John Wiley, 1984.

#### **MME 4072: MACHINE TOOL TECHNOLOGY [3 0 0 3]**

Working and Auxiliary motions in machine Tools, Parameters defining working motions of a machine tool, Machine tool drives-individual drive, Group drive, Mechanical Drives for providing rotational movements, Selection of range of spindle speeds, Typical layouts for intermediate spindle speeds, Construction of speed diagram, Layout of speeds in GP,

Saw diagram of a GP series, Rules for layout of speed boxes having sliding clusters, Flow Diagram, Ray diagram, Types of Feed Gear Boxes, Functions and Requirements of machine tool structures, Profiles, Factors affecting stiffness of machine tool structures & Methods of improving it, Commonly used bed and column sections, Antifriction guide ways, Protecting devices, Spindles, Milling & Drilling machines, Antifriction bearings, Elimination of vibration, Machine tool chatter, Vibration isolated tool holders.

#### **References:**

- Mehta N K, Machine Tool Design and Numerical control, Tata McGraw Hill Publishing Co. Ltd., 2012.
- Sen and Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2001.
- CMTI, Machine Tool Design Handbook, Tata McGraw Hill Publishing Co. Ltd., 2004.
- Basu S K, Design of Machine Tools, Oxford & IBH, 1989.
- George Schlesinger, Testing Machine Tools, Pergamon Press, 1982.

#### **MME 4061: MANAGEMENT INFORMATION SYSTEMS [3 0 0 3]**

Importance of MIS, Evolution of MIS, Computers and MIS, Typical Management Information Systems, Organizational and Information System Structure, Management and Decision making, Information Support for functional areas of management, Impact of Business on information Systems, Key ingredients of success, Organizing Information Systems, Computer hardware and Software, Telecommunications, Database management, Transaction, Processing and Reporting, Decision making and decision support system, AI and Expert system, Office information system, MIS as technique for programmed decision, Strategic and project planning, Conceptual design, Detailed design, Implementation, Evaluation and Maintenance, Controlling of IS, System concept, Case study in Hostel, Hospital, Hotel, Stores, Production Industries.

#### **References:**

- Davis G B and Olson M H, Management Information Systems, Tata McGraw Hill Education, 2005
- Laudon K C and Laudon J P, Management Information Systems, Pearson Education, 2006
- Sadagopan S, Management Information Systems, PHI Learning Pvt. Limited, 2002
- Murdick R G and Ross J E, Information Systems for Modern Management, PHI Learning Pvt. Limited, 1997
- O'Brien J A, Management Information Systems, McGraw Hill, 1999.

#### **MME 4074: MATERIALS CHARACTERIZATION [3 0 0 3]**

Introduction to Optical Microscopy, Principles of image formation and its Applications, Scanning Electron Microscopy. Principles, Resolution, Image Formation, Electron-specimen interaction, Ancillary techniques (EDS, BSDP, Cathodoluminescence, etc.), Science of Imaging and diffraction, Transmission Electron Microscopy, X-ray Diffraction, X-ray Fluorescence, Scanning Auger Microscopy, Electron Backscatter Diffraction (EBSD), Quantitative Micro and Nanostructure.

#### **References:**

- J. Goldstein, D. Newbury, D. Joy, C. Lyman, P. Echlin, E. Lifshin, L. Sawyer and J. Michael, Scanning Electron Microscopy and X-ray Microanalysis(3e), Springer Science, 2003.
- David B. Williams, C. Barry Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Springer publishers, 2009.

- Joseph I Goldstein, Dale E Newbury, Patrick Echlin and David C Joy, Scanning Electron Microscopy and X-Ray Microanalysis (3e), 2005.
- Ray Egerton, Physical Principles of Electron Microscopy, Springer Science 2005.

#### **MME 4092: MATERIALS MANAGEMENT [3 0 0 3]**

Concepts, evolution, importance and scope of materials management, organizational structure, man power planning, functions of management, principles of organisation, motivation, factors and techniques of materials planning & budgeting and budgetary control, purchasing, purchasing policy, purchasing parameters and purchasing procedures. Strategic materials planning, JIT production planning, strategic materials planning, Criteria for make or buy decision, spare parts management including equipment selection, codification and standardization. Capital equipment planning and capital equipment decision and purchase of capital equipment's.

#### **References:**

- Sharma S C, Materials Management and Materials Handling, Khanna Publishers, 2000
- Arnold J R T, Chapman S N and Ramakrishnan R V, Introduction to Materials Management, (5e), Pearson Education India, 2011
- Gopalakrishnan P and Sundareshan M, Material Management, PHI Publications, 1999.
- Datta K, Materials Management: Procedures, Text and Cases (2e), PHI Learning, 2008
- Chitale. A.K, Gupta. R. C, Materials management: Text and cases, PHI Learning, 2013.

#### **MME 4075: MEMS AND NANOTECHNOLOGY [3 0 0 3]**

General methods of preparation of nano particles, Carbon nanostructures and their Applications. Nanosized Structures, Physical chemistry of nanosystems, Nanoparticles, Nanowires and Nanorods, Thin films- Self assembled monolayers, Experimental techniques- Temperature measurement techniques, Atomic Force Microscopy, Scanning Tunneling Microscopy, Spectroscopy and Diffraction techniques. Micro Electro Mechanical Systems, MEMS, Micro and Nanoscale Thermal Engineering, Nanofluids preparation and Characterization, Properties of nanofluids, Nanomaterials used in energy and Environmental applications and their Properties. Device applications in hydrogen storage and Production, Fuel cells, Battery, Solar energy conversion, Waste water treatment, Pollution remedies, Nanomaterials in automobiles. Challenges and Scope.

#### **References:**

- Charles P Poole, Introduction to Nanotechnology, Wiley-Interscience Publication, 2003.
- Guozhong Cao, Nanostructures & Nanomaterials, Imperial College Press, 2004.
- Sobhan C B, Microscale and Nanoscale Heat Transfer, Taylor and Francis Publication, 2008.
- Mohamed Gad-el-Hak, The MEMS Handbook, Taylor and Francis Publication, 2005.
- James J Allen, MEMS Design, Taylor and Francis Publication, 2005.

#### **MME 4076: MICRO MACHINING [3 0 0 3]**

Definition of Micromachining, Need, Classification and Applications of micro machining, types of micro Machines, Micro cutting tools, Sensors and actuators. Traditional micro machining processes like turning, drilling, milling and grinding. Abrasive micro machining and nano

finishing, Ultrasonic micro machining, Magneto rheological finishing. Electric discharge micro machining, Wire electric discharge micro machining, Electric discharge grinding, Electric discharge diamond grinding, Laser beam micro machining, Electron beam micro machining, Ion beam micro machining. Chemical Micro machining, Electro chemical micro machining, Electro chemical micro grinding, Electro stream micro drilling, Electro chemical micro deburring, Shaped tube electrolytic micro machining. Bulk micro machining and its applications, Surface micro machining and its applications. Stiction and antistiction in micro machining. Hybrid micro machining like Wafer bonding - Anodic bonding, Fusion bonding, Thin film deposition techniques - CVD and PVD processes, Electro plating, Atomic layer deposition, Spin coating, Evaporation and Epitaxy, Laser ablation technique. Principles of photo lithography, Photo-mask and photo-resists, LIGA and micro molding techniques, Deep X-ray lithography and their applications.

#### **References:**

- Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor and Francis Group, 2012
- Mishra P.K., Nonconventional Machining, Narosa Publishers, 2007.
- McGeough J. A., Advanced Methods of Machining, Springer, 1988.
- Kahrizi M., Micromachining Techniques for Fabrication of Micro and Nano Structures, Intech, 2012.
- Gad-el-Hak M., The MEMS Handbook, Taylor and Francis, 2005.

#### **MME 4079: NON DESTRUCTIVE TESTING [3 0 0 3]**

Introduction and benefits of NDE, selection of NDE technique. Visual Inspections. Penetrant inspections principal, testing procedure and materials, testing methods and systems, sensitivity, standards, applications and limitations. Magnetic particle testing basic principle, testing procedure, equipment, sensitivity, standards, limitations. Ultrasonic testing principal, basic of about soundwave propagation, Ultrasonic Transducers, types of probes. Pulse echo and through transmission methods, normal and angle beam methods. Criteria for probe selection, ultrasonic techniques for stress measurement and material studies. Applications, merits, limitations, standards, standardization and calibration. Radiographic techniques: basic principle, Radiographic imaging film radiography, real-time radiography (radioscopy), radiographic tomography. Geometric factors, radiographic film. Exposure, radiographic sensitivity, evaluating image quality and sensitivity. Radiographic inspection techniques and systems. Applications of radiography in NDE, safety consideration in radiographic inspections. Eddy current testing, Principles and Instrumentation, 3D or phased array ECT. Sensitivity, advanced eddy current test methods, eddy current testing for conductivity and wall thickness, crack detection. Applications, limitations, standards. Eddy current instruments. Acoustic emission testing, principal, AE sensors, signal parameters, signal analysis, noise, data quality analysis, standards, applications. Thermography: principles, equipment, techniques, applications and codes and standards. Comparison and selection of NDT methods, Case study of NDT for damage inspection/detection and characterization, process monitoring and structural monitoring.

#### **References:**

- Don E Bray and Roderic K Stanley, Nondestructive Evaluation: A tool in design, manufacturing and service, Taylor and Francis Group, 1997.
- Paul E Mix, Introduction to Nondestructive Testing-A Training Guide (2e), John Wiley and Sons Inc., 2005.
- NDT Hand Books Vol. 1 – 10, American Society for Nondestructive Testing (ASNT), USA.

- Davis Joseph R., ASM Handbook: Volume 17, Nondestructive Evaluation and Quality Control, ASM International Materials Park, OH, 1989.
- ASNT (Edited), Materials and Processes for NDT Technology, ASNT, USA, 1981.

#### **MME 4078: NON-CONVENTIONAL ENERGY SOURCES [3 0 0 3]**

Potential of renewable energy resources and applications, Solar radiation at the earth's surface, Measurement of solar radiation, Solar radiation geometry, Empirical equations for predicting the availability of solar radiation, Thermal applications of solar energy, Liquid flat-plate collectors, Principles of wind power, Types of windmill, Site selection, Betz theory, Forces on the blades and thrust on turbines, Types of biomass, Types of biogas plants, Influencing factors for the generation of biogas, Aerobic fermentation, Ethanol production – from wood by acid hydrolysis and from sugar cane, Thermo-chemical method of bio-conversion, Pyrolysis method, Power from the wave, Wave energy conversion by floats - Oscillating float air pump and Buoy-Dolphin type, Tidal energy conversion by single pool system and two pool system, OTEC, Small scale hydel plant, Geothermal energy conversion, Direct energy conversion, Conversion of thermal energy into electricity, Thermo-electric converters, Thermo-ionic converters, Conversion of chemical energy into electricity-Fuel Cells, H<sub>2</sub>-O<sub>2</sub> acidic fuel cell, Conversion of electromagnetic energy into electricity, solar cells.

#### **References:**

- S P Sukatme, Solar Energy Principles of Thermal Collection and Storage, Tata Mc Graw Hill, 2005.
- M M El Wakil, Power plant Technology, McGraw Hill International, 1984.
- G D Rai, Non-conventional Energy Sources, Khanna Publications, 1997.
- S Rao and B B Parulekar, Energy Technology, Khanna Publishers, 2004.
- A W Culp Jr. Principles of Energy Conversion, McGraw Hill International, 2001.

#### **MME 4082: PLANT ENGINEERING AND MAINTENANCE [3 0 0 3]**

Introduction to plant engineering, Industrial buildings, Fire detection and suppression, Introduction to industrial flooring, Floor paints, Self-leveling systems, Heavy duty flooring, Ventilation systems and control, Water purification processes, Membrane processes, Effluents. Noise and Vibration control, Air pollution, Dust and fume control, Introduction to dust collection system, Bag houses, Cyclone separators, Introduction to air pollution, Legislation on air pollution, Maintenance, Responsibilities of the maintenance department, Breakdown maintenance, Scheduled maintenance, Preventive maintenance, Corrective maintenance, Total productive maintenance, Planning, scheduling and economic aspects of maintenance function, Estimation of maintenance work, Maintenance control, Maintenance scheduling, Life cycle costing, Maintenance budgeting and cost control., Techniques of condition monitoring.

#### **References:**

- Mobley K. R., Plant Engineer's Handbook, Butterworth-Heinemann, 2001.
- Snow A. D., Plant Engineer's Reference Book, Butterworth-Heinemann, 2000.
- Mobely, Higgins and Wikoff, Maintenance Engineering Handbook, McGraw-Hill, 2008.
- Mishra and Pathak, Maintenance Engineering and Management, PHI Learning Pvt. Ltd., 2012.
- Jyoti Mehrotra, Principles and Practice of Total Productive Maintenance, Allied Publishers Ltd., 1998.

#### **MME 4093: RAPID PROTOTYPING [3 0 0 3]**

Basic concepts, Comparison of conventional prototyping methods and Rapid prototyping technologies, Definition of Rapid prototyping, Fundamentals of Rapid prototyping and advantages, Overview of existing technologies of prototyping and tooling, Classifications of Rapid prototyping systems, State of the technology, Conceptual design, development, prototype, tooling, limitations, Accelerated product development, Rapid prototyping systems, Rapid prototyping data formats, Cost justification, Applications and examples of Rapid prototyping.

#### **References:**

- Chua C K, Leong K F and Lim C S, Rapid Prototyping: Principles and Applications, World Scientific, 2008.
- Jacobs Paul, Rapid prototyping and manufacture, Fundamentals of Stereolithography, 1992..
- Soenen R and Olling, Advanced CAD/CAM systems, Narosa Publishing House, 1995.
- Durvent W.R., The lithographic Handbook, Narosa Publishing House, 1995.
- Cooper K G, Rapid Prototyping Technology: Selection and Application, CRC Press, 2001.

#### **MME 4094: THEORY OF METAL FORMING [3 0 0 3]**

Fundamentals of Metal Working, Metallurgical aspects of metal forming, Classification of forging processes-Hammer or drop forging, Press forging, Open die forging and Closed die forging. Calculation of forging loads, Effect of forging on microstructure, Residual stresses in forging, Forces and geometry relationships in rolling. Theories of cold rolling and hot rolling, Analysis of the extrusion process, Hydrostatic extrusion, Extrusion of tubing, Rod and Wire drawing, Tube drawing processes, Residual stress in rod, Wire and Tubes. High Energy Rate Forming Processes Comparison of HERF and Conventional methods. Presses-Types and Selection of presses-Formability of sheet metals-Principle, Process parameters, Equipment and Application of Deep drawing, Spinning, Stretch forming, Plate bending, Press brake forming, Magnetic pulse forming. Super plastic forming, Electro forming, Fine blanking.

#### **References:**

- Kumar Surender, Technology of Metal Forming Processes, Prentice-Hall of India, 2008.
- Narayanasamy. R, Metalworking Technology, Prentice Hall, 1997.
- Dieter, Mechanical metallurgy, McGraw Hill, 1988.
- Nagpal. G.R., Metal forming processes, Khanna Publishers, 1998.
- George E., Dieter-Engineering Design, McGraw Hill, 2000.

#### **OPEN ELECTIVES**

#### **MME 4305: INTRODUCTION TO OPERATIONS RESEARCH [3 0 0 3]**

Introduction- Definition, Phases, Applications, Advantages and Limitations of Operations Research. Linear programming problems- Assumptions, Formulation of LPP, Graphical solutions, Simplex algorithm, Special cases. Concept of dual, Sensitivity analysis with respect to objective function coefficients and R.H.S. values. Transportation problem- Formulation, Testing the optimality. Assignment problem - Solution algorithm for Assignment Problem. Travelling salesman - Solution algorithm for Travelling Salesman Problem, Application to job sequencing problem Game theory- Introduction to game theory, Two-person-zero sum games, Pure and Mixed Strategies, Solution methods. Network Analysis- General frame work, Introduction to elements of network, conventions adapted in drawing network, analyzing the network. Calculation of event and Activity times, Critical



path, Determination of project duration, Project Crashing. Applications and Limitations of CPM. Project evaluation and review technique, Simulation:-Monte- Carlo technique, Problems involving Waiting line situations and Selection of crew members etc.

**References:**

1. Taha H. A., Operations Research, Pearson Education (7e), 2002.
2. W.L. Winston, Operations Research, Thomson Asia, 2003.
3. Vohra N. D., Quantitative Techniques in Management, 2007.
4. Sharma S. D., Operations Research (14e), Kedar Nath Ramnath Publications, 2005
5. Kanthiswaroop, Gupta and Manmohan, Operations Research, Sultan Chand and Sons, 2003.

**MME 4306: INTRODUCTION TO QUALITY CONTROL [3 0 0 3]**

Definitions of the term quality, Patterns of variation, Causes of variation Frequency distribution, Measures of central tendency and dispersion, The Normal distribution curve, Inequality theorems, Shewhart's bowl drawing experiments, Control charts for variables ( $\bar{X}$ , R and s charts), Type I and Type II Errors, Process capability analysis, Process capability

indexes, Control charts for attributes (p, np, c and u charts), Acceptance sampling by attributes, Single and Double sampling plans, Operating characteristic curve, Acceptable quality level, Lot tolerance percent defective, Average outgoing quality, Average total Inspection, Average fraction inspected, Producers risk, Consumers risk, Acceptance sampling tables, Conventional and Statistical tolerancing, Precision, Accuracy and Reproducibility of method of measurements, Quality costs.

**References:**

1. Grant E. L and Levenworth R., Statistical Quality Control, McGraw Hill Publications, 2005.
2. Mahajan M.S., Statistical Quality Control, Dhanpat Rai and Co. Pvt. Ltd., 2012.
3. Montgomery D.C., Introduction to Statistical Quality Control, John Wiley and Sons, 2005.
4. Juran J.M. and Gryna F.M., Quality Planning and Analysis, Tata McGraw Hill Publications, 1995.
5. Bertrand L. Hansen, Quality Control- Theory and Applications, Prentice Hall India, 1987.





## **OPEN ELECTIVES**

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

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

#### **References:**

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

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

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

#### **References:**

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

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

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

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

#### **References:**

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

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

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

#### **References:**

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

## **Minor Specialization: Computational Mathematics**

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

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

#### **References:**

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

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

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

#### **References:**

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

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

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

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

#### **References:**

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

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

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

#### **References:**

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

## **OPEN ELECTIVES**

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

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

**References:**

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

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

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

**References:**

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

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

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

**References:**

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

**MAT 5304: MATHEMATICAL MODELLING [2 1 0 3]**

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

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

**References:**

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

**MAT 5305: OPTIMIZATION TECHNIQUES [2 1 0 3]**

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

**References:**

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

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

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

**References:**

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

### **Minor Specialization: Business Management**

#### **HUM 4051: FINANCIAL MANAGEMENT [2 1 0 3]**

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

#### **References:**

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

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

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

#### **References:**

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

#### **HUM 4053: MARKETING MANAGEMENT [2 1 0 3]**

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

#### **References:**

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

#### **HUM 4054: OPERATIONS MANAGEMENT [2 1 0 3]**

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

#### **References:**

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



## **OPEN ELECTIVES**

### **HUM 4301: COMMUNICATIVE ENGLISH [3 0 0 3]**

(Offered for Lateral Entry Students only)

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

#### **References:**

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

### **HUM 4302: FILM STUDIES [2 1 0 3]**

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

#### **References:**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

### **HUM 4306: PUBLIC SPEAKING [3 0 0 3]**

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

#### **References:**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

### **HUM 4309: CREATIVE WRITING [3 0 0 3]**

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

#### **References:**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

### **HUM 4312: ENTREPRENEURSHIP [3 0 0 3]**

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

#### **References:**

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





## Minor Specialization: Material Science

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

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

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

#### **References:**

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

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

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

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

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

#### **References:**

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

## OPEN ELECTIVES

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

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

#### **References:**

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

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

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

#### **References:**

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

### **PHY 4303: RADIATION PHYSICS [3 0 0 3]**

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



**References:**

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

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

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

**References:**

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

**PHY 4305: MODERN OPTICS [3 0 0 3]**

Optics: Review of geometrical and physical optics, Dual nature of light, Electromagnetic spectrum, Optical devices, mirrors, lenses, prisms, grating, beam splitters, zone plate, polaroids. Light sources, emission profile. Elements of lasers: Basic requirements in a laser, characteristic properties of lasers. Q-switched and mode locked lasers. CO<sub>2</sub>, Nd: YAG lasers. Applications. Introduction to Non-linear optics. Optoelectronic devices and its application: Photo diodes, solar cells, LED, and diode lasers. DBR and DFB lasers, CCD. Optical Communication: Conceptual picture of the optical communication system, Modulation and Detection

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

**References:**

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

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

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

**References:**

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

### **Minor Specialization: Material Science**

#### **CHM 4051: CHEMICAL BONDING [3 0 0 3]**

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

#### **References:**

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

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

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

#### **References:**

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

### **OPEN ELECTIVES**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

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

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

#### **References:**

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

# Inter Institute Open Electives

## Centre for Creative and Cultural Studies (CCCS), Manipal

### IIE 4301: ART APPRECIATION [3 0 0 3]

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

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

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

## Manipal Institute of Management, Manipal

### IIE 4304: CORPORATE FINANCE [3 0 0 3]

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

#### References:

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

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

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

#### References:

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

### IIE 4306: BRAND MANAGEMENT [3 0 0 3]

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

#### References:

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

## Centre for Integrative Medicine & Research (CIMR)

### IIE 4307: YOGA [3 0 0 3]

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

## Subjects by Industry Experts

### IIE 4308: HEALTH ECONOMICS [3 0 0 3]

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

#### References:

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

### IIE 4309: DIGITAL MEDICINE [3 0 0 3]

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

#### References:

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

## Manipal College of Nursing Manipal

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

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

#### References:

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

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

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

#### References:

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

## Welcomegroup Graduate School of Hotel Administration, Manipal

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

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

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

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

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

#### References:

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

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

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

#### References:

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

## School of Communication, Manipal

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

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

#### References:

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



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

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

#### **References:**

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

### **IIE 4317: BASIC PHOTOGRAPHY [3 0 0 3]**

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

#### **References:**

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

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

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

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

#### **References:**

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

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

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

#### **List of Practical's:**

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

#### **References:**

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