University of Engineering & Management, Kolkata

B.Tech

in

Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

Syllabus

Semester 1									
Sl No	**Type of Course**	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Total Contact Hours**	**Credit Points**
Theory Papers									
1	Basic Science Course	BSC101	Physics	4	0	0	0	4	**4**
2	Basic Science Course	BSC103	Mathematics and Statistics- I	3	0	0	0	3	**3**
3	Engineering Science Course	ESC101	Basic Electrical Engineering	2	0	0	0	2	**2**
4	Humanities and social sciences including Management	HSMC101	English Communication and Public Speaking Skills-I	2	0	0	0	2	**2**
5	Humanities and social sciences including Management	HSMC102	Essential Studies for Professionals - I	2	0	0	0	2	**2**
			Total Credit Points of Theory	13	0	0	0	13	**13**
Practical Papers									
1	Basic Science Course	BSC191	Physics Lab	0	0	2	0	2	**1**
2	Engineering Science Course	ESC191	Basic Electrical Engineering Lab	0	0	2	0	2	**1**
3	Engineering Science Course	ESC192	Workshop &Manufacturing Practices - I	0	0	2	0	2	**1**
4	Humanities and social sciences including Management	HSMC191	English Communication and Public Speaking Skills - I Lab	0	0	2	0	2	**1**
Total Credit Points of Practical				0	0	8	0	8	**4**
Sessional Papers									
1	Engineering Science Course	ESC181	Computer Programming and Problem Solving using Python and C - I	1	0	0	3	4	**2**
2	Humanities and social sciences including Management	HSMC181	Economics, Finance and Entrepreneurship Skills - I	0	0	0	2	2	**1**
3	Humanities and social sciences including Management	HSMC182	Skill Development for Professionals – I	0	0	0	2	2	**1**
4	Humanities and social sciences including Management	HSMC183	Design Thinking & Innovation- I	0	0	0	1	1	**0.5**
5		MC181	Mandatory Additional Requirements (MAR)					0	**0.5**
Total Credit Points of Sessional				1	0	0	8	9	**5**
Total Credit Points of Semester				14	0	8	8	30	**22**

Semester 2									
Sl. No.	**Type of Course**	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Total Contact Hours**	**Credit Points**
Theory Papers									
1	Basic Science Course	BSC202	Chemistry	4	0	0	0	4	4
2	Basic Science Course	BSC203	Mathematics and Statistics- II	3	0	0	0	3	3
3	Engineering Science Course	ESC202	Basic Electronics Engineering	2	0	0	0	2	2
4	Humanities and social sciences including Management	HSMC201	English Communication and Public Speaking Skills-II	2	0	0	0	2	2
5	Humanities and social sciences including Management	HSMC202	Essential Studies for Professionals - II	2	0	0	0	2	2
			Total Credit Points of Theory	13	0	0	0	12	**13**
Practical Papers									
1	Basic Science Course	BSC292	Chemistry Lab	0	0	2	0	2	**1**
2	Engineering Science Course	ESC292	Basic Electronics Engineering Lab	0	0	2	0	2	**1**
3	Engineering Science Course	ESC293	Engineering Drawing, 3D Design Lab	0	0	2	0	2	**1**
4	Humanities and social sciences including Management	HSMC291	English Communication and Public Speaking Skills - II Lab	0	0	2	0	2	**1**
			Total Credit Points of Practical	0	0	8	0	8	**4**
Sessional Papers									
1	Engineering Science Course	ESC281	Computer Programming and Problem Solving using Python and C - II	1	0	0	3	2	**2**
2	Humanities and social sciences including Management	HSMC281	Economics, Finance and Entrepreneurship Skills - II	0	0	0	2	1	**1**
3	Humanities and social sciences including Management	HSMC283	Design Thinking & Innovation- II	0	0	0	1	0.5	**0.5**
4	Humanities and social sciences including Management	HSMC282	Skill Development for Professionals – II	0	0	0	2	1	**1**
5		MC281	Mandatory Additional Requirements (MAR)					0	**0.5**
Total Credit Points of Sessional				1	0	0	8	9	**5**
Total Credit Points of Semester				14	0	8	8	30	**22**

Semester : 3

Theory Papers

Sr. No	Type of Course	Course Code	Course Title	Hours per week					
				L	T	P	S	Total Contact Hours	Credit Point
1	Basic Science Course	BSC301	Mathematics & Statistics - III	3	0	0	0	3	**3**
2	Engineering Science Course	ESC301	Digital System Design	3	0	0	0	3	**3**
3	Engineering Science Course	ESC302	Computer Organization & Architecture	3	0	0	0	3	**3**
4	Professional Core Course	PCC-CS301	Data Structure & Algorithm	3	0	0	0	3	**3**
5	Professional Core Course	PCC-CS302	Discrete Mathematics	3	0	0	0	3	**3**
6	Humanities and social sciences including Management	HSMC301	Humanities – I (Constitution of India, Essence of India and Knowledge Trading)	2	0	0	0	0	**2**
7	Humanities and social sciences including Management	HSMC302	Essential Studies for Professionals - III	2	0	0		2	**2**
Total Credit Points of Theory				19	0	0	0	17	**19**

Practical Papers

Sr. No	Type of Course	Course Code	Course Title	Hours per week					
				L	T	P	S	Total Contact Hours	Credit Point
1	Engineering Science Course	ESC391	Digital System Design Laboratory	0	0	3	0	3	**1.5**
2	Engineering Science Course	ESC392	Computer Organization & Architecture Laboratory	0	0	3	0	3	**1.5**
3	Professional Core Course	PCC-CS391	Data Structure & Algorithm Laboratory (using C & Python)	0	0	3	0	3	**1.5**
Total Credit Points of Practical				0	0	9	0	9	**4.5**
Sessional Papers									
1	Professional Core Course	PCC-CS381	Artificial Intelligence & Machine Learning Fundamentals	0	0	0	3	3	**1.5**
2	Humanities and social sciences including Management	HSMC382	Skill Development for Professionals - III	0	0	0	2	2	**1**
3	Project	PROJ - CS381	Project - I	0	0	0	0	0	**1**
4	Mandatory Additional Requirements (MAR)	MC381	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
5	MOOCs (Mandatory for Honours)	MOOC 3	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	5	5	**7**
Total Credit Points of Semester				**19**	**0**	**9**	**5**	**31**	**30.5**

Semester : 4									
Theory Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**				**Total Contact Hours**	**Credit Point**
				L	**T**	**P**	**S**		
1	Basic Science Course	BSC401	Mathematics & Statistics - IV	3	0	0	0	3	**3**
2	Professional Core Course	PCC-CS401	Formal Language & Automata Theory	3	0	0	0	3	**3**
3	Professional Core Course	PCC-CS402	Design & Analysis of Algorithms	3	0	0	0	3	**3**
4	Professional Core Course	PCC-CS403	Database Management Systems	3	0	0	0	3	**3**
5	Professional Core Course	PCC-CS404	Computer Networks	3	0	0	0	3	**3**
6	Professional Core Course	PCC-CS405	Artificial Intelligence & Machine Learning Advanced	3	0	0	0	3	**3**
7	Humanities and social sciences including Management	HSMC401	Essential Studies for Professionals – IV	2	0	0	0	2	**2**
Total Credit Points of Theory				20	0	0	0	20	**20**
Practical Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**				**Total Contact Hours**	**Credit Point**
				L	**T**	**P**	**S**		
1	Professional Core Course	PCC-CS492	Design & Analysis of Algorithms Laboratory	0	0	3	0	3	**1.5**
2	Professional Core Course	PCC-CS493	Database Management Systems Laboratory	0	0	3	0	3	**1.5**
3	Professional Core Course	PCC-CS494	Computer Networks Laboratory	0	0	3	0	3	**1.5**
4	Professional Core Course	PCC-CS495	Artificial Intelligence & Machine Learning Advanced Laboratory	0	0	3	0	3	**1.5**
Total Credit Points of Practical				0	0	12	0	12	**6**
Sessional Papers									
1	Professional Core Course	PCC-CS481	Object Oriented Programming Using Java	0	0	0	3	3	**1.5**
2	Humanities and social sciences including Management	HSMC481	Skill Development for Professional – IV	0	0	0	2	2	**1**
3	Project	PROJ-CS481	Project – II	0	0	0	0	0	**1**
4	Mandatory Additional Requirements (MAR)	MC481	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
5	MOOCs (Mandatory for Honours)	MOOC 4	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	5	5	**7**
Total Credit Points of Semester				**20**	**0**	**12**	**5**	**37**	**33**

Semester : 5									
Theory Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Professional Core Course	PCC-CS501	Software Engineering	3	0	0	0	3	**3**
2	Professional Core Course	PCC-CS502	Operating Systems	3	0	0	0	3	**3**
3	Professional Core Course	PCC-CS503	Cloud Computing & IOT	2	0	0	0	2	**2**
4	Professional Elective Course	PEC-CS501	Professional Elective-I (Deep Learning / Cyber Security)	3	0	0	0	3	**3**
5	Professional Elective Course	PEC-CS502	Professional Elective-II (Soft Computing / Cyber Law, IPR& Ethics)	3	0	0	0	3	**3**
6	Humanities and social sciences including Management	HSMC501	Management - I (Principles of Management)	2	0	0	0	2	**2**
7	Humanities and social sciences including Management	HSMC502	Essential Studies for Professionals – V	2	0	0	0	2	**2**
Total Credit Points of Theory				18	0	0	0	18	**18**
Practical Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Professional Core Course	PCC-CS591	Software Engineering Laboratory	0	0	3	0	3	**1.5**
2	Professional Core Course	PCC-CS592	Operating Systems Laboratory	0	0	3	0	3	**1.5**
3	Professional Core Course	PCC-CS593	Cloud Computing & IOT Laboratory	0	0	3	0	3	**1.5**
Total Credit Points of Practical				0	0	9	0	9	**4.5**
Sessional Papers									
4	Humanities and social sciences including Management	HSMC582	Skill Development for Professional – V	0	0	0	2	2	**1**
5	Project	PROJ-CS581	Project – III	0	0	0	0	0	**1**
6	Mandatory Additional Requirements (MAR)	MC581	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
7	MOOCs (Mandatory for Honours)	MOOC 5	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	2	2	**5.5**
Total Credit Points of Semester				**18**	**0**	**9**	**2**	**29**	**28**

Semester : 6

Theory Papers

Sr. No	Type of Course	Course Code	Course Title	Hours per week					
				L	T	P	S	Total Contact Hours	Credit Point
1	Professional Core Course	PCC-CS601	Compiler Design	3	0	0	0	3	**3**
2	Professional Core Course	PCC-CS602	Network Security & Cryptography	3	0	0	0	3	**3**
3	Professional Elective Course	PEC-CS601	Professional Elective III (Big Data Analytics / Embedded Systems)	3	0	0	0	3	**3**
4	Professional Elective Course	PEC-CS602	Professional Elective IV (Natural Language Processing / Blockchain Technology)	3	0	0	0	3	**3**
5	Open Elective Course	OEC-CS601	Open Elective I (Blockchain Technology / Big Data Analytics)	3	0	0	0	3	**3**
6	Humanities and social sciences including Management	HSMC601	Management - II (Software Project Management)	2	0	0	0	2	**2**
7	Humanities and social sciences including Management	HSMC602	Essential Studies for Professionals – VI	2	0	0	0	2	**2**
Total Credit Points of Theory				19	0	0	0	19	**19**

Practical Papers

Sr. No	Type of Course	Course Code	Course Title	Hours per week					
				L	T	P	S	Total Contact Hours	Credit Point
1	Professional Core Course	PCC-CS691	Compiler Design Laboratory	0	0	3	0	3	**1.5**
Total Credit Points of Practical				0	0	3	0	3	**1.5**

Sessional Papers

1	Humanities and social sciences including Management	HSMC682	Skill Development for Professional – VI	0	0	0	2	2	**1**
2	Project	PROJ-CS681	Project – IV	0	0	0	0	0	**1**
3	Mandatory Additional Requirements (MAR)	MC681	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
4	MOOCs (Mandatory for Honours)	MOOC 6	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	2	2	**5.5**
Total Credit Points of Semester				**19**	**0**	**3**	**2**	**24**	**26**

Semester : 7									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Basic Science Course	BSC701	Biology	2	1	0	0	3	**3**
2	Basic Science Course	BSC702	Environmental Sciences	2	0	0	0	2	**1**
3	Professional Elective Course	PEC-CS701	Professional Elective V (Computer Vision / Digital Forensics)	3	0	0	0	3	**3**
4	Open Elective Course	OEC-CS701	Open Elective II (Cyber Security / Deep Learning)	3	0	0	0	3	**3**
5	Open Elective Course	OEC-CS702	Open Elective III (Cyber Law, IPR & Ethics / Natural Language Processing)	3	0	0	0	3	**3**
6	Humanities and social sciences including Management	HSMC701	Humanities - II (Economics & Financial Accounting)	2	0	0	0	2	**2**
7	Humanities and social sciences including Management	HSMC702	Essential Studies for Professionals – VII	2	0	0	0	2	**2**
Total Credits of Theory				17	1	0	0	18	**17**
Sessional Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Humanities and social sciences including Management	HSMC782	Skill Development for Professional – VII	0	0	0	2	2	**1**
2	Project	PROJ-CS781	Project – V	0	0	0	0	0	**3**
3	Mandatory Additional Requirements (MAR)	MC781	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
4	MOOCs (Mandatory for Honours)	MOOC 7	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	2	2	**7.5**
Total Credit Points of Semester				**17**	**1**	**0**	**2**	**20**	**24.5**

Semester : 8									
Theory Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Professional Core Course	PCC-CS801	Quantum Computing	3	0	0	0	3	**3**
2	Open Elective Course	OEC-CS801	Open Elective IV (Digital Forensics / Computer Vision)	3	0	0	0	3	**3**
3	Humanities and social sciences including Management	HSMC801	Essential Skills for Professionals – VIII	2	0	0	0	2	**2**
Total Credit Points of Theory				8	0	0	0	8	**8**
Sessional Papers									
Sr. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**					
				L	**T**	**P**	**S**	**Total Contact Hours**	**Credit Point**
1	Humanities and social sciences including Management	HSMC881	Skill Development for Professional – VIII	0	0	0	2	2	**1**
2	Project	PROJ-CS881	Project-VI / Corporate Internship (Full Time)	0	0	0	0	0	**6**
3	Grand Viva	PCC-CS881	Grand Viva-Voce	0	0	0	0	0	**1**
4	Mandatory Additional Requirements (MAR)	MC881	Mandatory Additional Requirements (MAR)	0	0	0	0	0	**0.5**
5	MOOCs (Mandatory for Honours)	MOOC7	Massive Open Online Courses (Mandatory for B.Tech(Honours))	0	0	0	0	0	**3**
Total Credit Points of Sessional				0	0	0	2	2	**11.5**
Total Credit Points of Semester				**8**	**0**	**0**	**2**	**10**	**19.5**

Professional Elective Courses

SL. NO.	SEMESTER	AI & Machine Learning track	IoT, Cybersecurity & Blockchain track
PEC-1	Sem - 5	Deep Learning	Cybersecurity
PEC-2	Sem - 5	Soft Computing	Cyber Law, IPR & Ethics
PEC-3	Sem - 6	Big Data Analytics	Embedded Systems
PEC-4	Sem - 6	Natural Language Processing	Blockchain Technology
PEC-5	Sem - 7	Computer Vision	Digital Forensics

Open Elective Courses

SL. NO.	SEMESTER	AI & Machine Learning track	IoT, Cybersecurity & Blockchain track
OEC-1	Sem - 6	Blockchain Technology	Big Data Analytics
OEC-2	Sem - 7	Cybersecurity	Deep Learning
OEC-3	Sem - 7	Cyber Law, IPR & Ethics	Natural Language Processing
OEC-4	Sem - 8	Digital Forensics	Computer Vision

Physics
Code: BSC101

Credit: 4

Pre-requisites (if any)	(i) Mathematics course on Differential equations (ii) Introduction to Electromagnetic theory

Module 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7 L)

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator

Module2: Wave optics (6 L)

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 3: Lasers (8 L)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Module 4: Wave nature of particles and the Schrodinger equation (8 L)

Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time- independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

Module 5: Applying the Schrodinger equation (15 L)

Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Numerical solution of stationary-state Schrodinger equation for one dimensional problem for different potentials

Scattering from a potential barrier and tunneling; related examples like alpha-decay, field-ionization and scanning tunneling microscope

Three-dimensional problems: particle in three dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbital's, interaction with magnetic field, spin.

Numerical solution stationary-state radial Schrodinger equation for spherically symmetric potentials

Suggested Text Books

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. Ghatak, Optics
4. O. Svelto, Principles of Lasers
5. Eisberg and Resnick, Introduction to Quantum Physics
6. .D. J. Griffiths, Quantum mechanics
7. Richard Robinett, Quantum Mechanics
8. Daniel McQuarrie, Quantum Chemistry

Physics Laboratory

Code: BSC191

Credit : 1

- **List of experiments**

Group A

- To determine the value of Planck's constant using photo electric effect
- To verify inverse square law
- To determine e/m ratio of electron by J.J Thomson method
- Determination of Band gap of Semiconductor by four probe method
- Measurement of Hall coefficient
- Verification of Stefan's law

Group B

- Newton's Ring
- Determination of thickness of wedge shaped film
- Laser Diffraction
- Optical Fibre Experiment
- Rigidity modulus by dynamic method
- Determination of 'g' using Bar Pendulum
- Determination of wavelength by Melde's Experiment

a) A student is required to perform ***eight experiments*** taking ***at least three*** from each group. Emphasis should be given on the estimation of error in the data taken.

b) Innovative experiment:

(i) An experiment designed by the student or the concerned teacher or both.

(ii) In addition a student should perform one more innovative experiment (or innovative model) designed him/her.

d) Project work and Technical Presentation: A student has to undertake a project work (individual/group) on a topic related to application of physics and make a technical presentation on the same topic.

Mathematics and Statistics- I

Code: BSC103

Credit: 3

Module 1: Calculus: (6 lectures)
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 lectures)
Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Matrices: (8 lectures)
Determinants, Inverse of a matrix, Linearly independent and dependent set of vector; Rank of a matrix, Solution of system of linear equation, Cramer's Rule, Gauss elimination and Gauss-Jordan elimination. Eigen values and eigenvectors, Diagonalization of matrices, Cayley-Hamilton Theorem and Orthogonal transformation.

Module 4: Multivariable Calculus (Differentiation): (14 lectures)
Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutatively, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables, Lagrange s method of multipliers.

Module 5: Vector Algebra and Vector Calculus: (10 lectures)
Scalar and vector fields – definition and terminologies, dot and cross products, scalar and vector triple products and related problems, Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative. Related problems on these topics. Green's theorem, Gauss Divergence Theorem and Stoke's theorem (Statements and applications).

Suggested Text/Reference Books

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(iii) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

(iv) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

(v) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

(vi) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

(vii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Code : ESC101

Credit: 2

Module 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Principle of operation & construction,Emf equation,ideal and practical transformer,Impedance transformation,Phasor diagram on no load & full load, equivalent circuit, losses in transformers, regulation and efficiency,Open & Short circuit tests of a transformer.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor.Construction, working,Excitation schemes of DC machines,Emf equation,Torque equation,Armature reaction,Torque-speed characteristic and speed control of separately excited dc motor.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Learning Resources:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Basic Electrical Engineering Laboratory

Code : ESC191

Credit : 1

Choose 10 experiments from the following:

1. First activity: Introduction to basic safety precautions and mentioning of the do's and Don'ts. Noting down list of experiments to be performed, and instruction for writing the laboratory reports by the students. Group formation. Students are to be informed about the modalities of evaluation.

2. Introduction and uses of following instruments :

   (a) Voltmeter

   (b) Ammeter

   (c) Multimeter

   (d) Oscilloscope

   Demonstration of real life resistors, capacitors with color code , inductors and auto transformer.

3. Demonstration of cut-out sections of machines: DC machine, Induction machine, Synchronous machine and single phase induction machine.

4. Calibration of ammeter and Wattmeter.

5. Determination of steady state and transient response of R-L, R-C and R-L-C circuit to a step change in voltage.

6. Determination of steady state response of R-L and R-C and R-L-C circuit and calculation of impedance and power factor.
7. Characteristic of carbon and tungsten lamp.
8. Characteristic of fluorescent lamp.
9. Verification of network theorems(Thevenin, Superposition and Maximum power transfer theorem)

10. Analysis of series R-L-C circuit.
11. Analysis of parallel R-L-C circuit.

12. Open circuit and short circuit test of a single-phase transformer

13. Demonstration of three phase transformer connections. Voltage and current relationship, phase shifts between the primary and secondary side.

14. Measurement of power in a three phase unbalanced circuit by two wattmeter method.

15. Determination of Torque –Speed characteristics of separately excited DC motor.

16. Speed Control of DC Shunt Motor.

17. Determination of Torque speed characteristics and observation of direction reversal by change of phase sequence of connection of Induction motor.

18. Determination of operating characteristics of Synchronous generator.

19. Demonstration of operation of (a) DC-DC converter (b) DC-AC converter (c) DC-AC converter for speed control of an Induction motor

20. Demonstration of components of LT switchgear.

English Communication and Public Speaking Skills-I

HSMC101

Credit: 2

MODULE-1 (ENGLISH LANGUAGE: GRAMMAR & VOCABULARY), (6L)

Correction of Errors in Sentences , Building Vocabulary, Word formation, Single Word for a group of Words, Fill in the blanks using correct Words, Sentence Structures and Transformation, Active & Passive Voice, Direct & Indirect Narration (MCQ Practice during classes)

MODULE-2 (READING COMPREHENSION), (6L)

Strategies for Reading Comprehension, Short Stories for Comprehension, Practicing Technical & Non Technical Texts for Global/Local/Inferential/Referential comprehension; Précis Writing, Essay/Paragraph writing

MODULE-3 (TECHNICAL COMMUNICATION), (6L)

The Theory of Communication –Definition & Scope , Barriers of Communication, Different Communication Models, Effective Communication (Verbal / Non verbal), Presentation / Public Speaking Skills, (MCQ Practice during classes)

MODULE-4, (MASTERING TECHNICAL COMMUNICATION) (6L)

Technical Report (formal drafting); Business Letter (formal drafting); Job Application (formal drafting); Organizational Communication: Memo, Notice, Agenda, Minutes Group Discussion –Principle & Practice

BOOKS – RECOMMENDED:

1. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015
2. Objective English, Prasad and Sinha, Tata McGraw Hill Education Pvt. Ltd,2013
3. English Grammar, Wren and Martin, Regular Edition
4. Fantasy- A Collection of Short Stories,V. Sashikumar,Orient Black swan (Reprint 2006)
5. Proficiency in Reading Comprehension, Ajay Singh, Paperback, 2015
6. Selected Contemporary Essays, Soumitra Mohan, Paperback, 2016

English Communication and Public Speaking Skills - I Laboratory

Code: HSMC191

MODULE-1 (LISTENING) (2L)

Listening Skill & its sub skills (Assignment: Listening to story or read aloud passage or newspaper reading, and then answering the questions set from that passage), like-, Oral Comprehension-Story, Oral Comprehension-Newspaper report, Oral comprehension-Conversation played by audio-visual devices

MODULE-2 (SPEAKING) (4L)

Speaking Skill & its sub skills (Assignment: Storytelling, Debate, Oral Presentation) for helping students to master Linguistic/Paralinguistic features (Pronunciation, Phonetics, Voice modulation, Stress, Intonation, Pitch &Accent) of connected speech (Assignment: Language Functions-Permission, Request, Order, etc), like- Story telling practice- Individual work, Story telling- Pair work, Story telling-Group work, Just-a Minute(JAM) Session, Face to face conversation, Telephonic conversation, Role Play Mode, Mobile Phone

MODULE-3 (READING) (2L)

Reading Skills and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non Technical Passages; Learning Global / Contextual / Inferential Comprehension (Assignment: Comprehension passages: Question answer sessions), like-Newspaper reading, Technical topics reading, Story reading and summarizing.

MODULE-4 (WRITNG) (3L)

Writing Skill: Practice Sessions. Writing practice hones expressive potential of students, thereby accentuating the correct usage of vocabulary. (Assignment: Story writing, Essay writing, etc) like Paragraph Writing, Instruction Writing, Essay Writing, Rearranging jumbled sentences, Antonyms and Synonyms, Word formation : Prefixes and Suffixes, Word formation : Homonyms and Homophones, Comprehension passages: Question answer sessions.

Essential Studies for Professionals – I

Code: HSMC102

Credits: 2

Detailed contents:

Section A: Finance and Entrepreneurship Skill (10 lectures)

Module 1: Indian Financial System in India (4 lectures)

Financial Concepts, Financial Assets, Financial Intermediaries, Financial Markets, Classification, Components of Financial Market, Financial Instruments, Multiplicity of Financial Instruments.

Module 2: Basic Concepts of Marketing (4 lectures)

Basic concepts of Money Market, Basic Concepts of New Issues Market, Secondary Market: Basic Concepts, Objectives, Features of NSE- Comparative analysis of BSE & NSE functioning

Module 3: Personal Financial Services and Retail Banking (2 lectures)

Debit Card, Credit Card, Housing & Personal Loans, Mortgage Loan, Auto Loans and Education Loans.

Section B : Employment Enhancement Skills (10 lectures)

Module 1 : Number System (3 lectures)

Numbers, Face value and place value of a digit, Types of numbers, Tests of Divisibility, Factorial of a number, Modulus of a number, greatest integral value, Multiplication by short cut methods, Division Algorithm.

Module 2 : HCF and LCM of Numbers (2 lectures)

Factors and Multiples, HCF or GCD, LCM, Product of two numbers, Co-primes, HCF and LCM of fractions, HCF and LCM of decimal fractions, Comparison of fractions.

Module 3 : Average (1 lecture)

Module 4 : Percentage (2 lectures)

Concepts, Results on population, Results on Depreciation

Module 5: Profit and Loss (2 lectures)

Cost Price, Selling Price, Profit or Gain, Loss

Section C: Foreign Language: Basics – Mandarin (10 lectures)

Developing Oral Skills [Intensive and Supplementary Vocabulary]

- **Greetings**: Introduction to Chinese Phonetics; Writing System; Tones; Spelling Rules; Inquiring about Health, Work and Family; Conveying Regards
- **Introducing oneself and others:** Teacher-Student Introduction; Introducing one's Institute; Introducing a Foreigner Friend
- **Asking for personal information**: Name, Native Country, Address, Telephone Number, Family Members
- **Talking about date**, Month, Year; Days of the Week; Birthday
- **Talking about time**: Office Hours; School Hours
- **Talking about age**: Ways to Express Age
- **Talking about plans** - during Weekend, Holidays, Business Trip, on Study and Future
- **Talking about study**: About one's Institute, Number of Students, Courses, Specialization; Personal Opinions on Study
- **Talking about work**: Professions, Place of Work,, Working Hours
- **Buying tickets** – on a Bus, at the Train Ticket Office, at the Theatre Box Office - Phoning an Airline Ticket Office - Reading a Train Ticket
- **Shopping** – at a Fruit Stand, in a Snack Bar, at a Clothes Stand, in a Department Store, at the Check-Out Counter of a Supermarket - How to Express the Amount of Money
- **Talking about location**: Position of Objects in a Room - Describing a Photograph - Location of Buildings
- **Talking about hobbies:** Kind of Hobbies - Most Favourite Hobby - Favourite Pastime -

Interest in Specific Fields - Liking and Disliking

- **Congratulations and wishes**: at a Birthday Party, for Exams, attending a Wedding Ceremony, in a Hospital

Section E: Yoga, Games and Meditation (10 sessions)

Session 1 – Asana sitting postures and Karate.

Session 2 - Asana lying in supine & prone position and karate.

Session 3 – Surya Namaskar , Asana standing posture and Karate.

Session 4 – Kriyas, Pranayam and Karate.

Session 5 – Meditation and Karate.

Session 6 - Meditative posture and Karate.

Session 7 – Tratak, Kapalbhati and Meditation.

Session 8 – Meditation and Stress Management.

Session 9 – Meditation, Stretching and Self Defense.

Session 10- Meditation, Kicking and Punching of Karate.

(Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Skill Development for Professionals - I

Code: HSMC182

Credits: 1

Module-I

Economic Affairs - I

1) **Basic economics**- Types of Economy, Branches of economics, Feature of Indian Economy, HDI.
2) Economic situation at Independence
3) **Economic Planning**; 5 year Plan, Successes and Failures; Significant developments: Green Revolution, Heavy Industries, Imports Substitutions, etc
4) **Sectors of the economy and their analysis**: Primary (Agriculture, Mining, etc), Secondary (Industry, various policies), Tertiary (services, etc), Others.
5) Liberalisation, Privatisation and Globalisation
6) **Global Trade**: Imports and Exports
7) **Employment situation**, challenges of demographic transitions
8) **Economic Growth and development**: global economic recession / downturn and challenges
9) **Poverty, Socio-Economic Situation, Inclusive growth**: rural and urban development
10) Human Capital development
11) Sustainable development

Module-II

Indian Constitution and Governance

1) **Historical background** (in brief) - The company Rule (1773-1858), The crown rule (1858-1947), making of constitutions, features of constitution.

2) **The Preamble**- Ingredients, keywords, amendment of preamble.
3) **Part & schedule**
4) **Citizenship** (in brief) - Constitutional provisions, Citizenship act, Comparing PIO & OCI card holders.
5) **Fundamental Rights**- Concept & different articles, Right to equality, prohibition of discrimination on certain ground, Equality of opportunity, abolition of untouchability & titles, right to freedom, right to education, right against exploitation, right to freedom of religion, cultural & educational rights, different writes & scopes.

6) **DPSP**- Classification of directive principle, sanctioned of directive principal, criticism, Distinction between fundamental rights & directive principle

7) **List of Fundamental duties,** criticism, significance, Verma committee.
8) **Features of parliament govt**. Features of Presidential Govt. Merits & Demerits.
9) Duties of **President & Vice President** & their selection, Provision & scopes
10) Duties of **PM, CM** & **Governor** & their selections

Module-III

Earth Sciences-I

1) **Geomorphology:** Origin of the earth; Geological Time Scale; Interior of the earth; Types and characteristics of rocks; Folding and Faulting; Volcanoes; Earthquakes; Weathering; Landforms caused by fluvial, aeolian and glacial actions.
2) **Climatology:** Structure and composition of atmosphere; Temperature; Pressure belts and Wind systems; Clouds and rainfall types; Cyclones and anticyclones; Major climatic types.
3) **Oceanography:** Ocean relief; Temperature; Salinity; Ocean deposits; Ocean currents, El Nino and La Nino; Waves and tides.
4) **Biogeography:** Origin and types of soils; Major biomes of the world; Ecosystem and food chain; Environmental degradation and conservation

Module-IV

Quantitative Aptitude

1) **Quant foundation**- Vedic Maths & Collective tricks.
2) **Basic Multiplication** – multiplying by numbers ending in zeroes, Multiplying by 2,3,4,5,6,7,8,9, 11,12 & 111.Multiplying 2 digits numbers ending in 9 & whose tens digit at to 10,Multiplying by 2 digits number of 9, multiplying by any 2 digit numbers ending in 9
3) **Division**- Divisibility by 2,3,4,5,6,7,8, 9, 11 & 13; Dividing by 5,9, 15,25,125,Dividing by
Factors.
4) **Squaring numbers**- squaring any 2 digit numbers ending in 5, squaring any number ending in 5,squaring any 3 digit numbers ending with 25, squaring any numbers

ending in 9, squaring any numbers consisting only nines. Squaring any 2 digit numbers. Cube & cube roots.

5) **Percentage**- Basic concept of percentage & it's shortcut rules & their applications.
6) **Ratio**- Basic concept of Ratio & Proportion, Shortcut tricks & their applications.
7) **Simple equation**- Linear equation of 2 & more than two variables.
8) **Variation**- Ratio , Proportion, Variation, concept of directly proportional &
9) **Partnership** – concept, rules & Applications, Percentage Advanced problems & shortcuts.
10) **Profit & Loss**- Basic concept, formulae, shortcut tricks & their Application.

Module-V

Logical Mental ability -1

1) **Coding And Decoding & Direction Sense**
   a) Conditional Coding, b)Word-Pattern Coding, c)Chinese Coding, d)Direction Sense Test,
   e)Direction Distance Test, f)Shadow based Questions
2) **Series & Numbers**
   a)Alphabet Series, b)Random Series, c)Number Series, d)Letter Gap, e)Missing Number Series, f)Series Completion, g)Order And Ranking, h)Interchange, i)Comparison
3) **Blood Relations**
   Family Tree Questions, Indication Type BR, Coding Blood Relations, Miscellaneous Blood Relations
4) **Analogy**
   Word Analogy, Classification, Odd-Out

Module-VI

Objective English-1

1) **Introduction of Parts of speech**: Introduction, Brief discussion of Parts of speech
2) What is **noun**, Kinds of Noun, Rules & Application.
3) Definition of **Pronoun**, Examples, Rules & Application
4) Definition of **Verb**, Kinds of Verb, Rules & Application, Definition of Tense, Different types of Tenses, Examples, Rules & Application
5) Definition of **Adjective**, Kinds of Adjective, Rules & Application,
6) Definition of **Adverb**, Kinds of Adverb, Rules & Application
7) Definition of **Preposition**, Examples , Rules & Application,
8) Definition of **Interjection**, Examples, Rules & Its Application,
9) Definition of **Conjunction**, Examples, Rules & Application
10) Different types of **Articles**, Examples, Rules & Application English Grammar.

Computer Programming and Problem Solving using Python and C – I

Code: ESC181

Credit : 1

Detailed contents

Unit 1: Introduction to Programming (**4 lectures**)

- Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture).
- Idea of Algorithm: steps to solve logical and numerical problems. Representation of
- Algorithm: Flowchart/Pseudo code with examples. (1 lecture)
- From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- (2 lectures)

Unit 2: Arithmetic expressions and precedence (**2 lectures**)

Unit 3: Conditional Branching and Loops (**3 lectures**)

- Writing and evaluation of conditionals and consequent branching (1 lectures)
- Iteration and loops (2 lectures)

Unit 4: Arrays (**3 lectures**)

- Arrays (1-D, 2-D)
- Character arrays and Strings

Unit 5: Basic Algorithms (**3 lectures**)

- Notion of order of complexity through example programs
- Searching
- Basic Sorting Algorithms (Bubble, Insertion).

Unit 6: Function (**3 lectures**)

- Functions (including using built in libraries)
- Parameter passing in functions, call by value
- Passing arrays to functions: idea of call by reference

Unit 7: Recursion (**2 lectures**)

- Recursion, as a different way of solving problems. Example programs, such as Finding

Factorial, Fibonacci series, Ackerman function etc.

- Quick sort or Merge sort.

Unit 8: Structure (**2 lectures**)

- Structures, Defining structures and Array of Structures

Unit 9: Pointers (**2 lectures**)

- Idea of pointers
- Defining pointers
- Use of Pointers in self-referential structures
- Notion oflinked list (no implementation)

Unit 10: File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice

Hall of India

Course Outcomes:

The student will learn

 To formulate simple algorithms for arithmetic and logical problems.

 To translate the algorithms to programs (in C language).

 To test and execute the programs and correct syntax and logical errors.

To implement conditional branching, iteration and recursion.

 To decompose a problem into functions and synthesize a complete program using

divide and conquer approach.

 To use arrays, pointers and structures to formulate algorithms and programs.

 To apply programming to solve matrix addition and multiplication problems and

searching and sorting problems.

 To apply programming to solve simple numerical method problems, namely rot

finding of function, differentiation of function and simple integration.

All experiment must be done using gcc or dev c/Turbo c

Assignment 1 : implementation of various operators in C

Assignment 2 : Design of different patterns , accessing lists and other structures using loops. Implementation of different conditional statements.
Assignment 3: Switch case
Assignment 4: Array fundamentals
Assignment 5: Advanced array programming
Assignment 6: Pointers
Assignment 7: Creation of array using pointers
Assignment 8: Structures and union
Assignment 9: Creation of basic data structures using pointers and structure
Assignment 10: Dynamic memory allocation
Assignment 11: pre-processor and their utility
Assignment 12: File handling programs in C

Economics, Finance and Entrepreneurship Skills - I

Code : HSMC181

Contacts: 2L

Credit: 0.5

MODULES	DETAILS	HOURS
I. LISTENING	1. Listening to stories, newspaper articles 2. Oral Comprehension 3. Dialogue/ Conversation	**(4L)**

II. SPEAKING 4.Group discussion, debate, Oral Presentation, Just A Minute (JAM) **(10L)**
5. Language Function Permission – Request, Order
6. Practice of Phonetics, Pronunciation, Voice modulation, Accent and voice through passage reading
7. Story-telling, Roleplay model (telephonic conversation, situation)

III. READING 8. Read and analyze through passages, diagrams, graphics, technical and non technical passages **(6L)**
9. Learn to read Global, inferential, Contextual Comprehension

10. Story writing, Passage writing, Essay writing
11. Rearranging Jumbled Sentences
12. Word formation : Prefixes and Suffixes, Homonyms and Homophones, Question and Answer – Comprehension Passages

Design Thinking & Innovation- I

Code : HSMC183

Credit: 0.5

Course Outcomes:

The course titled Design Thinking & Innovations is designed to give an in-depth understanding on various aspects of thinking, innovations, creativity, evolving business models, incubation and entrepreneurship. The course also includes sessions on Engineering and Technology incubation which will help everyone as a game changer in nowadays competitive scenario. The course is a blend of theory and practice. As the course is designed for B. Tech 1st year students therefore this course does not require any prerequisite knowledge except Mathematics and Basics of C programming language and will be useful to understand innovation and its applications in different areas of development and growth.

Detailed contents:

Module 1: Introduction to Design thinking (**1 lecture**)

Module 2: Empathy: Problem Discovery & Evoking the 'right problem' (**1 lecture**)

Module 3: Research and Analysis: Context Research and Design Insights and Strategy (**1 lecture**)

Module 4: Solve: Concepting and Building – Generating Ideas, Building Ideas and Create a Concept (**1 lecture**)

Module 5: Testing, Refine and Enhance Design (**1 lecture**)

Module 6: Workshop: Case studies (**5 lectures**)

- Computer Science Related problems (**2 lectures)**
- Mechanical Engineering problem (**1 lecture)**

- Electrical Engineering problem (**1 lecture)**
- Electronics Engineering problem (**1 lecture**)

Links: No standard text books are available. If needed see the links below.

(i) https://nptel.ac.in/courses/110/106/110106124/

(ii) https://nptel.ac.in/courses/109104109/

Workshop &Manufacturing Practices – I

Code : ESC192

Credit: 1

Fitting shop **(4 hours)**

Typical jobs that may be made in this practice module:

- To make a Gauge from MS plate.

Carpentry **(4 hours)**

Typical jobs that may be made in this practice module:

- To make wooden joints and/or a pattern or like.

Smithy **(4 hours)**

Typical jobs that may be made in this practice module:

- A simple job of making a square rod from a round bar or like.

Machine shop **(8 hours)**

Typical jobs that may be made in this practice module:

- To make a pin from a mild steel rod in a lathe.
- To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Electrical & Electronics I **(4 hours)**

- Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable.
- Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point.
- Simple wiring exercise to be executed to understand the basic electrical circuit.

1st Year 2nd Semester

Chemistry

Code: BSC202

Credit: 4

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i) Atomic and molecular structure (10 lectures) Schrodinger equation. Particle in a box solutions and their applications for simple sample. Molecular orbitals of diatomic molecules (e.g.H2). Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their
magnetic properties. Band structure of solids and the role of doping on band structures.

ii) Spectroscopic techniques and applications (8 lectures) Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic
resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

iii)Intermolecular forces and potential energy surfaces (4 lectures) Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

iv) Use of free energy in chemical equilibria (8 lectures) First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy.
Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibrium. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

v) Periodic properties (4 Lectures) Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

vi) Stereochemistry (4 lectures) Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

vii) Organic reactions and synthesis of a drug molecule (4 lectures) Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Outcomes
The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels.

The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy

levels in various spectroscopic techniques

- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and

electronegativity.

- List major chemical reactions that are used in the synthesis of molecules.

Learning Resources: 1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi
2. University chemistry, by B. H. Mahan
3. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
4. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
5. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
6. Physical Chemistry, by P. W. Atkins
7. Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Publishers
8. Physical Chemistry, P. C. Rakshit, Sarat Book House
9. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Mathematics and Statistics- II

Code: BSC203

Credit: 3

Module No	Description	Lecture Hours
1	**Basic Statistics** Measures of Central tendency- Mean, Median & Mode and the empirical relation among them. Related problems, Measures of Dispersion- Variance and its properties. Related problems, Moments (central & raw), Skewness and Kurtosis. **Text Book: Chapters 25 of B.S. Grewal, Higher Engineering Mathematics, KhannaPublishers, 43rd Edition**	**4**
2	**Random variables & Theoretical distributions (Discrete & Continuous)** Definition of Random variables (Discrete & Continuous).Probability mass function, Probability density function & Distribution function for a single variable & their properties. Expectation and variance of a random variable.Related problems. Discrete theoretical distributions-Binomial distribution-its pmf, mean & variance. Poisson distribution its pmf, mean & variance. Poisson distribution as a limiting form of the Binomial distribution. Related problems Continuous theoretical distributions- Uniform distribution-its pdf, mean & variance. Exponential distribution-its pdf, mean & variance. Normal distribution-its pdf, mean & variance. Standard normal variate and its distribution. Related problems **Text Book: Chapter 26 (from article 26.7-26.20) of B.S. Grewal, Higher Engineering Mathematics, KhannaPublishers, 43rd Edition**	**7**

3 **Linear Algebra (Matrices):** **8**

Determinant of a square matrix, Minors & Cofactors, Laplace's method of expansion of a determinant up to 4^{th} order, Adjoint of a determinant, Jacobi's theorem on the adjoint of a determinant (3^{rd} order).Singular and non-singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, symmetric and skew-symmetric matrices, orthogonal matrix and its properties, Trace of a matrix. Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by matrix inversion method, Consistency and inconsistency of a system of homogeneous and non-homogeneous linear simultaneous equations, Eigen values and eigen vectors of a square matrix (of order 2 or 3), Caley-Hamilton theorem and its applications, Diagonalization of matrix (up to 3^{rd} order).

Text Book: Chapter 7 of B.Basu Mallik & Krishanu Deyasi, Engineering Mathematics-1B, CengageLearning

4 **Ordinary Differential Equations:** **6**

First order and first degree: Exact equations, condition of exactness, solution of exact differential equation. Non exact Differential equation: Rules for finding Integrating Factors, Linear equation, Bernoulli's equation.

First order and higher degree: Equations not of first degree: equations solvable for p, equations solvable fory,equationssolvableforxandClairaut'stype..

Higher order and first degree: General linear ODE with constant coefficients, C.F. & P.I., D-operator methods for finding P.I., Method of variation of parameters, Linear differential equation with variable coefficients: Cauchy-Euler equations, Solution of simultaneous linear differential equations.

5 **Applications of Ordinary Differential equations** **10**

Geometric Applications of ODE, orthogonal Trajectories, Physical applications of ODE: Problems related to: Motion of a boat across a stream,Resisted vertical motion, Rotating cylinder containing liquid, velocity of escape from earth, discharge of water from a small hole, atmospheric pressure, Simple Electrical circuits, Newton's Law of cooling, Heat flow, Rate of decay of radioactive materials, chemical reactions and solutions.Application of Linear Differential Equations: Problems related to Simple Harmonic Motion, Simple pendulum, oscillation of a spring, oscillatory electrical circuit, electromechanical analogy, deflection of beams, whirling of shafts. Application of Linear simultaneous Differential Equations: Projectile with resistance.

Text Book: Chapter 2 & 3 of B.Basu Mallik & Krishanu Deyasi, Engineering Mathematics-2B, CengageLearning

Text Book: Chapters 12 and 14 of B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36^{th} Edition, 2010

6 **Sequence & Series:** **7**

Preliminary ideas of sequence, Infinite series and their convergence/divergence, Infinite series of positive terms, Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test,

Raabe's test(statements and related problems on these tests), Alternating series, Leibnitz's Test (statement, definition) and related problems, Absolute convergence and Conditional convergence; Taylors series, series for exponential, trigonometric and logarithmic function.

Applications with respect to Physical problems.

Text Book: Chapter 3 of B.Basu Mallik & Krishanu Deyasi, Engineering Mathematics-1B, CengageLearning

Total **42**

Basic Electronics Engineering

Code : ESC203

Credit: 2

Module 1: *Electronics* covering, Semiconductor Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance

Module 2: *Diodes and Applications* covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications;

Module 3*: Transistor and Applications* covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 4*: Operational Amplifiers and Applications* covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground; Different applications using Op-Amp.

Basic Electronics Engineering Laboratory

Code: ESC291

Credit: 1

Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors and LEDs;

Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO;

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

Module 4: Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier;

Module 5: Op-Amp Applications – Inverting and Non-inverting amplifier, Adder, Subtractor, Voltage Follower and Comparator, Differentiator and Integrator;

Module 6: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR

Text/Reference Books:

1. David. A. Bell (2003), *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall, India
2. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
3. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals* by Pearson Education
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), *Basic Electronics – A Text-Lab. Manual,* TMH
5. R. T. Paynter (2009), *Introductory Electronic Devices & Circuits, Conventional Flow Version,* Pearson

English Communication and Public Speaking Skills-II

Code: HSMC201

Credit: 2

Pre requisites: Basic Grammar, Comprehension, Writing skills.

Course Objective:

- To enable students listen, speak, read and write effectively for academic purposes and face real life situations.

Expected Course Outcome:

- Facilitate students to communicate effectively in academic and social contexts.
- Make students industry ready.
- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Module 1 (Communication Skills) (3 L)

Purpose of communication, understanding Inter and Cross cultural nuances, importance of Communication in Business, Barriers to Communication; Measures to Overcome the Barriers to Communication. CBLL (Content Based language learning)

Module 2 (Fundamentals of Grammar) (3 L)

Vocabulary Building, concepts of word formation, single word for a group of words, phrasal verbs, idioms, synonyms, antonyms, transformation of sentences, error spotting, importance of punctuation and practice.

Module 3 (Advanced Technical Writing) (3 L)

Proposal writing: project proposal for getting funds for university building, road repairing, start up of website, establishment of share trading company, proposal for building construction business.

Module 4 (Precis and comprehension) (3 L)

Rules of Precis writing, practicing Precis to increase writing skills. Comprehension

Module 5 (Advanced Writing) (3 L)

Essay writing, formal letter, cover letter, official letter, Employment Communication – Resume: Contents of Good Resume; Guidelines for Writing Resume; Different Types of Resumes; Reason for a Cover Letter to Apply for a Job-Format of Cover Letter; Different Types of Cover Letters, official email, notice, letter of application for leave to HOD/ higher officials.

Module 6 (Technical Writing) (3 L)

Writing reports on Technical topics.

Fundamentals of writing research paper.

Module 7 (Advanced Language Lab practice) (3 L)

Listening: casual and academic

Reading: Skimming and scanning, extensive reading, news paper reading.

Speaking: Storytelling, discussion about current affairs, mock job/ placement interviews.

Module 8 (Public speaking skills, Level 1) (3 L)

Introducing Oneself

Extempore

JAM (just a minute)

Role play

Creating a digital/online profile: LinkedIn, video CV.

Module 9 (Public speaking skills, Level 2) (3 L)

Developing persuasive skills- Turncoat and debate

Group Discussion on factual, controversial and abstract issues

Module 10 (Advanced presentations skills) (3 L)

Presentations skills

Power point presentation

English Communication and Public Speaking Skills-II Laboratory

Code: HSMC291

Credit: 1

M0DULE-1 (6L)

Listening: Listening Skill & its sub skills helps the students to improve their concentration power, simultaneously honing their vocabulary. (Assignment: Listening to passages read aloud and then answering the questions set from that passage, and so forth), like- Dialogue Practice Sessions, Oral Comprehension. Conversation Practice Sessions: Situational Dialogue, Role Play, Use of Audio aids for Conversation Practice, Use of Video Clips for Conversation Practice

M0DULE-2 (8L)

Presentation: It helps to teach students effective communication through innovative methods of learning, like Individual Presentation, Group Presentation, Using Powerpoint/OHP in Presentation, Project Work on PowerPoint Presentation, Paper Presentation. Public Speaking and Soft Skills: Just A Minute (JAM) Sessions

M0DULE- 3 (6L)

Grammar and Vocabulary: Students will be able to communicate ideas effectively and powerfully using correct grammar and appropriate vocabulary. Related areas include topics like-Connectives, Modifiers, Idiomatic Usage, Online exercises on Grammar and Vocabulary. Report Writing: Report Writing - Principles and Practice

M0DULE-4 (8L)

GROUP DISCUSSION: Prepares B.Tech first year students for various aspects of their social and professional lives through interactive sessions, handouts, workshops, self-assessment, peer assessment, and teacher assessment. Related activities include, Group Discussion - Principles and Practice

BOOKS – RECOMMENDED:

1. Advanced English Communication Skills Lab, Lakshminarayan, Paperback, 2015
2. English Language Laboratories-A Comprehensive Manual, Nira Konar, (OUP), 2016
3. Advanced Grammar in Use with Answers: A Self-Study Reference and Practice Book for Advanced Learners of English 3rd Edition, Martin Hewings, Paperback, 2015
4. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015

5. English Grammar, Wren and Martin, Regular Edition
6. The Art of Public Speaking, 10th Edition, Stephen E. Lucas , McGraw-Hill, 2008

Engineering Drawing, 3D Design Laboratory

Code: ESC293

Contacts: 2L+2P

Credit: 1

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

Module 1: Introduction to Engineering Drawing :

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections:

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids:

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4: Sections and Sectional Views of Right Angular Solids:

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Module 5: Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphic:

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation & CAD Drawing

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Annotations, layering & other functions:

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two- dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Module 9: Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

(iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

(iv)Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

(v) (Corresponding set of) CAD Software Theory and User Manuals

Essential Studies for Professionals – II

Code: HSMC202

Credit: 2

Detailed contents:

Section A: Finance and Entrepreneurship Skill (10 lectures)

Module 1: Corporate Finance: Basic Concepts **(3 lectures)**

Module 2: Time Value of Money: Basic Concepts **(2 lectures)**

Module 3 : Capital Budgeting: Basic Concepts and Principles, PBP, NPV, IRR. **(3 lectures)**

Module 4: Cost of Capital: Basic Concepts and Problems, WACC **(2 lectures)**

Section B: Employment Enhancement Skill (10 lectures)

Module 1 : Ratio and Proportion (2 lectures)

Ratio, Proportion, Proportional, Comparison of Ratios, Compounded Ratios, Duplicate Ratio, Triplicate Ratio, Variation.

Module 2: **Time ,Work and Distance (2 lectures)**

Module 3: Alligation or Mixture (2 lectures)

Alligation, Mean price, Rule of Alligation

Module 4: Clocks and Calendar (2 lectures)

Clocks, Odd days, Leap Year, Ordinary year, Counting of odd days, Day of the week related to odd days.

Module 5: Permutations and Combinations (2 lectures)

Factorial n, Permutations, Combinations.

Section C: Foreign Language: Basics – Mandarin (10 lectures)

Outline of Grammar

Chinese Numerals - Nominal Classifiers – Sentences with Adjectival Predicate - Interrogative Sentences - Structural Particle - Verbs and Verbal Classifiers - Interrogative Pronouns and Prepositions - Sentences with Nominal Predicate - Affirmative-Negative Questions - - Modal Particle indicating Change - Alternative Questions - Confirmation Question - Approximate Numbers - Aspect Particle indicating Completion of Action - Reduplication of Verbs - Modal Verbs

Section E: Yoga, Games and Meditation (10 sessions)

Session 1 – Asana sitting postures and Karate.
Session 2 - Asana lying in supine & prone position and karate.
Session 3 – Surya Namaskar , Asana standing posture and Karate.
Session 4 – Kriyas, Pranayam and Karate.
Session 5 – Meditation and Karate.
Session 6 - Meditative posture and Karate.
Session 7 – Tratak, Kapalbhati and Meditation.
Session 8 – Meditation and Stress Management.
Session 9 – Meditation, Stretching and Self Defense.
Session 10- Meditation, Kicking and Punching of Karate.
(Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Chemistry Laboratory

Code: BSC292

Credit: 1

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1. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
2. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
3. Determination of dissolved oxygen present in a given water sample.
4. To determine chloride ion in a given water sample by Argentometric method (using chromate
indicator solution)
5. Determination of surface tension and viscosity
6. Thin layer chromatography
7. Ion exchange column for removal of hardness of water
8. Determination of the rate constant of a reaction
9. Determination of cell constant and conductance of solutions
10. Potentiometry - determination of redox potentials and emfs
11. Saponification/acid value of an oil
12. Chemical analysis of a salt
13. Determination of the partition coefficient of a substance between two immiscible liquids
14. Adsorption of acetic acid by charcoal
15. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg .

Computer Programming and Problem Solving using Python and C – II

Code : ESC281

Credit: 2

Module 1:

Introduction: Basic Terminologies:

Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations,

Module 2:

Stacks and Queues:

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis, The Tower of Hanoi, Eight Queens Puzzle. Principles of recursion - use of stack, differences between recursion and iteration, tail recursion

ADT Queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3:

Linked Lists:

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Module 4:

Trees:

Basic terminologies, forest, tree representation (using array, using linked list).

Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree-operations (creation, insertion, deletion, searching).Height balanced binary tree – AVL tree (insertion, deletion with examples only).B- Trees – operations (insertion, deletion with examples only).

Module 5:

Graph:

Definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list.

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).

Module 6:

Sorting and Hashing:

Time-Space trade off. Searching: Linear Search, Binary Search and Interpolation Search Techniques and their complexity analysis. Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Module 7:

Principles of Object Oriented Programming:
Basic concepts of OOPs, Difference between OOPs and conventional programming, Basic idea of OOPs properties – Inheritance, Polymorphism, Abstraction, Encapsulation (Only Examples).

Recommended Reference Books:

Data Structures in C" by Aaron M. Tenenbaum.

1. Data Structures" by S. Lipschutz.
2. Data Structure Using C, Balagurusamy
3. "Data Structures Using C" by Reema Thareja.

"Data Structures Through C" by Yashavant P. Kanetkar

Design Thinking & Innovation- II
Code : HSMC283
Credit: 0.5

Course Outcomes:

The course titled Design Thinking & Innovations is designed to give an in-depth understanding on various aspects of thinking, innovations, creativity, evolving business models, incubation and entrepreneurship. The course also includes sessions on Engineering

and Technology incubation which will help everyone as a game changer in nowadays competitive scenario. The course is a blend of theory and practice. As the course is designed for B. Tech 1st year students therefore this course does not require any prerequisite knowledge except Discrete Mathematics, C programming language, Data Structures and will be useful to understand innovation and its applications in different areas of development and growth.

Detailed contents:

Module 1: Introduction to Design Thinking (Recapitulation) (**1 lecture**)

Module 2: Empathy: Problem Discovery & Evoking the 'right problem' (Advanced topics) (**1 lecture**)

Module 3: Research and Analysis: Context Research and Design Insights and Strategy (Advanced topics) (**1 lecture**)

Module 4: Solve: Concepting and Building – Generating Ideas, Building Ideas and Create a Concept (Advanced topics) (**1 lecture**)

Module 5: Testing, Refine and Enhance Design and Define pitch (Advanced topics) (**1 lecture**)

Module 6: Workshop: Case studies (**5 lectures**)

- Algorithm related to Facebook (**2 lectures)**
- Evolution of Algorithms for fundamental Mathematical & Statistical operations **(1 lecture)**
- Algorithm related to digital electronics problem (**2 lectures)**

Links: No standard text books are available. If needed see the links below.

(i) https://nptel.ac.in/courses/110/106/110106124/

(ii) https://nptel.ac.in/courses/109104109/

Skill Development for Professionals – II
Code : HSMC282
Credit: 1

Module-I

Economic Affairs – II

Macroeconomics

1) **National income**- Concept of GDP, GNP, NNP both in FC & MP, PCI
2) **Tax** – Concept of TAX , objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.
3) **Government Budgeting,** fiscal policy, concept of budget, components of budget, different types of deficit
4) **RBI & Banking** (**in brief)** - Traditional Functions of RBI, CRR, SLR, REPO, Reverse repo, MSF, LAF, money market, capital market, FOREX.
5) **Keynesian outlook** (in brief) - IS,LM & different multipliers.

6) **Inflation & Deflation** - Inflation & its impact, Deflation & its impact, WPI, CPI, GDP deflator.

Microeconomics (Conceptual understanding only)

1) **Production**- Factors of production, fixed inputs, variable inputs, PPC, concept of TP, AP, MP, concept of revenue, AR, MR.
2) **Demand & Supply**- law of demand, factors of demand, law of supply, different elasticity.
3) **Cost** (in brief) - Concept of implicit & explicit cost, sunk cost, opportunity cost, shapes of FC, AFC, AC, MC, VC, AVC. Relation between AR & MR, AC & MC.
4) **Market structure**- perfect competition, monopoly, oligopoly, duopoly, monophony, duopoly, oligopoly.

Module-II

Indian Constitution and Governance

1) **Central State relation**, Interstate relation,
2) **Supreme Court**-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review.
3) **High Court**-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review
4) Duties & Powers of **Attorney & Advocate General** (in brief)
5) Panchayati Raj- Three tier system, Different committees recommendation
6) **Municipality, Municipal Council & Corporation**, Official Languages & related Articles.
7) **UPSC** (**in brief):** Formation, Related Articles, Scope & Power, Duties of **CAG**, Formation **SPSC**, Related Articles, Scope & Power.
8) **Election Commission** (in brief) - Related Articles, Power & Function & Provision of Election
9) **Emergency Provisions** (in brief)- Related Articles, Conditions Application, Supreme power during emergency.
10) **National Commission for SC/ST/OBC** (in brief)**:** Function of the commissions, Special offer & related articles for SC/ST/OBC
11) **Different amendments** (in brief) of Indian Constitution & the related articles

Module-III

Earth Sciences-II

Human Geography

1) (In brief) Man and Environment Relationship; Growth and development of Human Geography; Concepts of Determinism and Possibilism.
2) Population Races of mankind and tribes; growth and distribution of world population; migration; population problems of developed and developing countries.
3) Economic Activities (in brief): Food gathering and hunting; pastoral herding; fishing and forestry;
4) Primary -- Types of agriculture-shifting, subsistence, commercial and plantation; Mining,
5) Secondary -- Manufacturing - location factors of textile, iron and steel, sugar and fertilizer industries; Power;
6) Tertiary activities -- trade, transport, communication and services.
7) Regional development

World Geography

1) **Major Natural Regions**: Characteristics, economic base and human adaptation.
2) **Regional Geography of Developed Countries**: Canada, U.S.A., Western Europe, Russia, Japan, Australia and New Zealand.
3) **Regional Geography of Developing Countries**: S.E. Asia, S.W. Asia, China, Southern Africa and Brazil.
4) **Regional Geography of South Asia**

Module-IV

Quantitative Aptitude

1) **Average**- Concept on average, different missing numbers in average estimation, shortcuts & their application.
2) **Mixture & Allegation** – Proportion & mixtures in percentages, populations & liquids, shortcuts & their application.
3) **Number System**- concept of different numbers , remainder theorem, factors.
4) **Time & Work**- Basic concept, Different problems & their shortcut tricks. Time & Speed & Tides- concept of speed, time & Distance, relative speed, formulae & their application. upstream & Downstream, Pipes & cistern.

Module-V

Reasoning

1) **Cube** Dice, Miscellaneous Problems
2) **Data Sufficiency**
   a)Problems on Blood Relation, ages, Numbers
   b)Logical Test Based on Data Sufficiency
3) **Non Verbal Reasoning**
   a)Image Formation
   b)Water –Images
   c)Mirror Image
   d)Image completion
   e)Paper Cutting And Folding
4) **Syllogism**
   a) Logical Venn Diagram
   b) The If Else Statement
5) **Puzzles**
   a) Seating Arrangement
   b) Classification
   c) Seating Arrangement with Blood relations
6) **Machine Input-Output**
   a) Pattern Based I/O

Module-VI

Objective English-2

1) **Clauses**: Definition, Examples, Rules & Application, Types of Sentences (Simple+Complex+Compound) Examples, Rules & Application, Voice- Concept, Types, Examples, Rules & Application, Narration Change- Rules (Direct & Indirect Speech)
2) **Vocabulary**- : Synonyms, Antonyms with examples, One word Substitution, Idioms & Phrases
3) **Spotting Errors**
4) **Reading Comprehension** (Level1)

Economics, Finance and Entrepreneurship Skills – II

Code: HSMC281
Credit: 1

Module 1: Economy:
[3 Hrs]

1. What is Economy?
2. What are the different types of Economy?
3. How is the state of Economy measured?
4. What are the factors that influence the Economy?

Module 2: Finance:
[2 Hrs]

1. What is Finance?
2. What are the types of Finance?
3. Importance of understanding finance fundamentals.

Module 3: Entrepreneurship:
[5 Hrs]

1. What is Entrepreneurship?
2. How Entrepreneurship is different from Innovation?
3. What are the characteristic of an Entrepreneur?
4. Different stages of an Entrepreneurial venture.
5. Abridged case studies of successful Entrepreneurs.

2nd year 3rd Semester

Course Code: BSC301

Course Title: Mathematics & Statistics – III

Credit: 3

Multivariate Calculus (Integration):

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, change of variables (Cartesian to Polar), Applications: Areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian); Vector line Integral, Vector surface Integral, Theorems of Green, Gauss & Stokes (statement only) and related problems.

Complex Variables:

Differentiation of complex functions, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithmic) and their properties; Conformal mappings, Mobius transformations and their properties.

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Taylor's series & Laurent's series, zeros of analytic functions, singularities, Poles, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Theory of Probability:

Basic terminology, Classical & Axiomatic definition of probability, Some elementary deductions- 0 P(A) 1, P(A) 1 P(A) etc., Addition rule for two events (proof) & three events (statement only) - Related problems, Concept of Conditional probability, Multiplication rule of probability, Bayes' theorem (statement only)-related problems, Independent events – properties and related problems.

Random variables & Theoretical distributions (Discrete & Continuous):

Definition of Random variables (Discrete & Continuous).Probability mass function, Probability density function & Distribution function for a single variable & their properties. Expectation and variance of a random variable.Related problems.

Discrete theoretical distributions-Binomial distribution-its pmf, mean & variance. Poisson distribution its pmf, mean & variance. Poisson distribution as a limiting form of the Binomial distribution. Related problems

Continuous theoretical distributions- Uniform distribution-its pdf, mean & variance. Exponential distribution-its pdf, mean & variance. Normal distribution-its pdf, mean & variance. Standard normal variate and its distribution. Related problems.

Learning Resources:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 43 rd Edition.

3. B.Basu Mallik & Krishanu Deyasi, Engineering Mathematics-2B, Cengage Learning.

4. Michael Greenberg, Advanced Engineering Mathematics, Pearson

5. Jain & Iyengar, Advanced Engineering Mathematics, Narosa.

6. H.K.Dass, Advanced Engineering Mathematics, Sultan Chand.

7. S. Ross, A First Course in Probability, Pearson Education India

8. Gupta & Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons

9. Miller & Freund's, Probability and Statistics for Engineers, Pearson Education.

10. Spiegel M R., Schiller J.J. and Srinivasan R.A.: Probability and Statistics (Schaum's Outline Series), TMH.

11. John E. Freund, Ronald E. Walpole, Mathematical Statistics, Prentice Hall.

Course Code: ESC301

Course Title: Digital System Design

Credit: 3

Module 1:

Binary Number System & Boolean Algebra (recapitulation) [1L];

BCD, ASCII, EBCDIC, Gray codes and their conversions [2L];

Signed binary number representation with 1's and 2's complement methods [1L],

Binary arithmetic, Venn diagram, Boolean algebra (recapitulation) [1L];

Representation in SOP and POS forms [1L];

Minimization of logic expressions by KMAP [3L]

Quine-McCluskey Minimization Technique (Tabular Method) [2L]

Binary Number System & Boolean Algebra (recapitulation) [1L];

BCD, ASCII, EBCDIC, Gray codes and their conversions [2L];

Signed binary number representation with 1's and 2's complement methods [1L],

Binary arithmetic, Venn diagram, Boolean algebra (recapitulation) [1L];

Representation in SOP and POS forms [1L];

Minimization of logic expressions by KMAP [3L]

Quine-McCluskey Minimization Technique (Tabular Method) [2L]

Module 2

Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor) [2L];

Encoder,Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator [4L].

Module 3

Sequential Circuits - Basic Flip-flop & Latch [1L],

Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops [3L]

Registers (SISO,SIPO,PIPO,PISO) [2L],

Ring counter, Johnson counter [1L],

Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), [2L],

Design of Mod N Counter [2L]

Module 4:

A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only [2L]

A/D: successive approximation [2L]) (4L)

Logic families- TTL, ECL, MOS and CMOS - basic concepts.(2L)

Learning Resources:

1. Digital Logic Design by Morris Mano - PHI

2. Digital Electronics by S. Salivahanan,S. Arivazhagan-OXFORD

3. Digital Electronics by P.Raja - Scitech Publications

4. Digital Fundamentals by Floyed & Jain -Pearson.

5. Microelectronics Engineering by Sedra & Smith-Oxford.

6. Principles of Electronic Devices & circuits by B L Thereja & Sedha, S Chand Digital Electronics, Kharate –Oxford

Computer Organization & Architecture

Course Code: ESC302

Course Title: Computer Organization & Architecture

Credit: 3

Module 1:

- Introduction to computer organisation & architecture

- Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler.

- Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes

- Quantitative techniques in computer design - Part1

- Introduction to RISC architectures. RISC vs CISC architectures

Module 2:

- Commonly used number systems. Fixed and floating-point representation of numbers; Concept of Overflow and Underflow.
- Design of adders - ripple carry and carry look ahead principles.
- Fixed point multiplication - Unsigned and Signed - Booth's algorithm.
- Fixed point division - Restoring and non-restoring algorithms.
- Floating point - IEEE 754 standard.
- Design of ALU.
- Design of control unit - hardwired and microprogrammed control.
- Introduction to Von-Nuemann & Harvard Architecture

Module 3:

- Memory organization, static and dynamic memory, memory hierarchy, associative memory.
- Hierarchical memory technology: Inclusion, Coherence and locality properties
- Cache memory organizations, Techniques for reducing cache misses;
- Virtual memory organization, mapping and management techniques, memory replacement policies.
- Memory unit design with special emphasis on implementation of CPU-memory interfacing. Data path design for read/write access.
- I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA

Module 4:

- Quantitative techniques in computer design - Part2

- Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards.

- Pipeline optimization techniques, Compiler techniques for improving performance.

- Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, superpipelined architectures. Array and vector processors.

Module 5:

- Multiprocessor architecture: taxonomy of parallel architectures - Introduction to Flynn’s Classification; Centralized shared - memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared memory architecture.

- Non von-Neumann architectures - Data flow computers.

Learning Resources:

1. Computer Organization and Architecture: Designing for Performance, William Stallings, Prentice-Hall India

2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Tata McGraw Hill

3. Computer Architecture A Quantitative Approach, John L Hennessy and David Patterson, Morgan Kaufman

4. Structured Computer Organization, Andrew S. Tanenbaum, Prentice-Hall India

5. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, Tata McGraw Hill

6. Computer System Architecture, M. M. Mano, PHI.

7. Computer Organization & Architecture, P N Basu, Vikas Publication

Course Code: PCC-CS301

Course Title: Data Structure & Algorithms

Credit: 3

Linear Data Structure:

Introduction:

Why we need data structure?

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.

Applications

Algorithms and programs, basic idea of pseudo-code.

Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array:

Different representations – row major, column major.

Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List:

Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Stack and Queue:

Stack and its implementations (using array, using linked list), applications.

Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications.

Recursion:

Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Applications - The Tower of Hanoi.

Nonlinear Data structures:

Trees:

Basic terminologies, tree representation (using array, using linked list).

Binary trees - binary tree traversal (pre-, in-, post- order), recursive and non-recursive traversal algorithms of binary tree, threaded binary tree (left, right, full), and expression tree.

Binary search tree- operations (creation, insertion, deletion, searching).

Height balanced binary tree – AVL tree (insertion, deletion with examples only).

B- Trees – operations (insertion, deletion with examples only).

B+ Trees – operations (insertion, deletion with examples only).

Graphs:

Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut vertex/ articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, and isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in

DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).

Searching and Sorting:

Sorting Algorithms: Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort.

Searching: Sequential search, binary search, interpolation search.

Hashing: Hashing functions, collision resolution techniques.

Learning Resources:

1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.

2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.

3. "Data Structures in C" by Aaron M. Tenenbaum.

4. **"**Data Structures" by S. Lipschutz.

5. "Data Structures Using C" by Reema Thareja.

6. “Data Structure Using C”, 2/e by A.K. Rath, A. K. Jagadev.

7. **“**Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Code: PCC-CS302

Course Title: Discrete Mathematics

Credit: 3

Propositional Logic:

Logical Connectives, Conjunction, Disjunction, Negation and their truth table. Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Biconditional statements with truth table, Logical Equivalence, Tautology, Normal forms - CNF, DNF; Predicates and Logical Quantifications of propositions and related examples.

Theory of Numbers:

Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic;

Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruences, Residue classes of integer modulo ( ) n n Z and its examples;

Order, Relation and Lattices:

POSET, Hasse Diagram, Minimal , Maximal, Greatest and Least elements in a POSET, Lattices and its properties, Principle of Duality, Distributive and Complemented Lattices.

Counting Techniques:

Permutations, Combinations, Binomial coefficients, Pigeon- hole Principle, Principles of inclusion and exclusions; Generating functions, Recurrence Relations and their solutions using generating function, Recurrence relation of Fibonacci numbers and it’s solution, Divide-and-Conquer algorithm and its recurrence relation and its simple application in computer.

Graph Coloring:

Chromatic Numbers and its bounds, Independence and Clique Numbers, Perfect Graphs- Definition and examples, Chromatic polynomial and its determination, Applications of Graph Coloring.

Matchings:

Definitions and Examples of Perfect Matching, Maximal and Maximum Matching, Hall’s Marriage Theorem (Statement only) and related problems.

Learning Resources:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill.
2. Russell Merris, Combinatorics, WILEY-INTERSCIENCE SERIES IN DISCRETE MATHEMATICS AND OPTIMIZATION
3. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI

4. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning.
5. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH

Course Code: HSMC301

Course Title: Humanities – I (Constitution of India, Essence of India and Knowledge Trading)

Credit: 2

Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Union government and its administration: Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. State government and its administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.

Supreme court: Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. High court: Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Learning Resources:

1. Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.

2. DD Basu, "Introduction to the constitution of India", 21st Edition, Lexis Nexis Books Publication ltd, India

Course Code: HSMC302

Course Title: Essential Studies for Professionals – III

Credit: 2

GK & CA, National income:

Concept of GDP, GNP, NNP both in FC & MP, PCI

Tax:

Concept of TAX, objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.

Market structure:

Perfect competition, monopoly, oligopoly, duopoly, monophony, duopoly, Oligopoly. SEBI, IRDA, NHB –Working & Policies, Money Market & Capital Market, functions of Banks & Types of accounts, cheques & loans, Mutual Fund, Banking Terminologies.

Science & technology (with current updates). Monuments, sculptures, Literature, Languages, Visual arts – paintings etc. ,Performing arts – classical and folk dances, puppetry etc. ,Religious diversity

Ancient & Medieval History at a glance-From Indus valley civilization to Pre-Foreign (British, Dutch, French) Invasion. Current Affairs.

Course Code: ESC391

Course Title: Digital System Design Lab

Credit: 1.5

1. 1.Realization of Basic Gates & Universal Gates .
2. 2.Realization of Basic Gates using Universal Gates.
3. 3.Realization of XOR and XNOR using Universal Gates
4. 4Realization of Boolean functions using Universal Gates only
5. Realization of Prime and Non-Prime Indicator Circuit
6. Realization of 2-bit comparator circuit
7. Realization of a 4bit Binary to Gray Code converter and vice-versa
8. Realization of a 4:1 multiplexer using basic gates.
9. Design of Odd/Even Parity Generator and checker circuit.
    a. Realization of S-R Latch using NAND gate.
    b. Realization of S-R Flip Flop using NAND gate.
10. Realization of J-K Flip Flop using NAND gate.
11. Realization of T Flip Flop using NAND gate.
12. Study of DAC .

Learning Resources:

1. Digital Logic Design by Morris Mano – PHI

2. Digital Electronics by S. Salivahanan,S. Arivazhagan-OXFORD

3. Digital Electronics by P.Raja - Scitech Publications

4. Digital Fundamentals by Floyed & Jain -Pearson.

5. Microelectronics Engineering bySedra & Smith-Oxford.

6. Principles of Electronic Devices & circuits by B L Thereja & Sedha, S Chand Digital Electronics ,Kharate –Oxford

Course Code: ESC392

Course Title: Computer Organization & Architecture Lab

Credit: 1.5

1. HDL introduction
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operations.
6. 8-bit simple ALU design
7. 8-bit simple CPU design
8. Interfacing of CPU and Memory

Learning Resources:

1. Computer Organization and Architecture: Designing for Performance, William Stallings, Prentice-Hall India
2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Tata McGraw Hill
3. Computer Architecture A Quantitative Approach, John L Hennessy and David Patterson, Morgan Kaufman
4. Structured Computer Organization, Andrew S. Tanenbaum, Prentice-Hall India
5. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, Tata McGraw Hill
6. Computer System Architecture, M. M. Mano, PHI.
7. Computer Organization & Architecture, P N Basu, Vikas Publication

Course Code: PCC-CS391
Course Title: Data Structure & Algorithm Lab
Credit: 1.5

1.Implementation of array operations: Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem: Evaluation of expressions operations on multiple stacks & queues.
2.Implementation of linked lists: inserting, deleting, and inverting a linked list.
3.Implementation of stacks & queues using linked lists, Polynomial addition,
4.Polynomial multiplication, Sparse Matrices: Multiplication, addition.
5.Recursive and No recursive traversal of Trees, Threaded binary tree traversal, AVL tree implementation.
6.Application of Trees. Application of sorting and searching algorithms.
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Course Code: PCC-CS381
Course Title: AI & Machine Learning Fundamentals
Credit: 1.5

Introduction to Artificial Intelligence [1L]: The Foundations of Artificial Intelligence, The History of Artificial Intelligence, and the State of the Art.
Knowledge Representation [4L]: A Knowledge-Based Agent, Knowledge Representation, Reasoning & Logic, Propositional Logic, Inference in First-Order Logic

Search techniques [4L]: AI-Problem formulation, Solving problems by searching, uninformed search strategies: depth first search, breadth first search, depth limited search, iterative deepening search, bi-directional search.
Heuristic search strategies [4L] : Basics of heuristics, hill climbing strategy, simulated annealing strategy, best-first search, A* search, constraint satisfaction problem solving strategy.
Adversarial search [2L]: AI-based interactive game playing scheme using the minimax strategy, alpha-beta pruning.
Introduction to Machine Learning [2L]: Machine learning and it's types; Applications of machine learning; Issues in machine learning.
Modelling and Evaluation [3L]: Selecting a model; Training model - Holdout, k-fold cross-validation, bootstrap sampling; Model representation and interpretability - under-fitting, over-fitting, bias-variance tradeoff; Model performance evaluation - Classification, regression, clustering; Performance improvement.
Supervised learning – Classification [4L]: k-Nearest Neighbour; Decision tree; Naive Bayes.
Supervised learning – Regression [1L]: Linear regression.
Unsupervised learning [2L]: k-Means, Association Analysis

Course Code: HSMC382
Course Title: Skill Development for Professional – III
Credit: 1

Quant Review- Miscellaneous problems from different chapters & short cuts. Indices & Surds- Basic concept, Formulae & their applications, Finding out the square roots, Elimination of Surds, Equation solve. Quadratic Equation- Polynomials, degree, powers, Equation & factors Solution. Progression- Concept of AP, GP & HP
1)Syllogism
a)Logical Venn diagram
b)The If Else Statement
2)Puzzles
a)Seating Arrangement
b)Classification
c)Seating Arrangement with Blood relations
3)Machine Input-Output
a) Pattern Based I/O
4)Inequality
a)Coded Inequality,
b) Jumbled Inequality,

c) Conditional inequality

1) Sentence Corrections

2) Fill the blanks with appropriate words/articles/ preposition/ verbs/adverbs/conjunction.

3) Reading Comprehension (Advance Level)

4) Vocabulary

Data interpretation Advanced Level. News paper reading: The Hindu & Economic Times.

Course Code: BSC401
Course Title: Mathematics & Statistics – IV
Credit: 3

1 Numerical Methods

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. Numerical solution of a system of linear equations: Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method. Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method. Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods. 14

2 Bivariate Probability Distributions

Bivariate distributions and their properties (discrete & continuous), marginal distribution, distribution of sums and quotients, conditional densities & independence. Related problems. 5

3 Regression

Concept of Regression. Regression Lines. To find the regression equations. Properties of Regression coefficients. Principle of LeastSquares, Method of fitting a straight line & a parabola to a given set of observations. Related Problems. 5

4 Sampling Theory

Random sampling (SRSWR & SRSWOR), parameter, stastistic and its sampling distribution. Standard error of statistic. Sampling distribution of sample mean & variance in random sampling from a normal distribution (statement only). Related problems. 6

5 Statistical Inference

Estimation of parameters: Unbiased & Consistent estimators. Point & interval estimations. Maximum likelihood estimation of parameters (Binomial, Poisson, & Normal).Confidence intervals & Related problems. Testing of Hypotheses: Its definition-Null & Alternative Hypothesis, Critical Region, Level of significance, Type I and Type II errors, Best Critical Region. Related problems. Large sample tests: Large sample test for single mean, difference of means, single proportion, difference of proportions, standard deviations. Small sample tests: Small sample test for single mean, difference of means & correlation coefficient. Test for ratio of variances - Chi-square test for goodness of fit & independence of attributes. 12

Learning Resources:

1. S. Ross, A First Course in Probability, Pearson Education India

2. Miller & Freund's, Probability and Statistics for Engineers, Pearson Education.

3. Spiegel M R., Schiller J.J. and Srinivasan R.A.: Probability and Statistics (Schaum's Outline Series), TMH

4. Gupta & Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons

5. John E. Freund, Ronald E. Walpole, Mathematical Statistics, Prentice Hall.

6. B.S. Grewal, Numerical Methods, Khanna Publishers

7. Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution), New Age International

8. Balagurusamy: Numerical Methods, Scitech.

9. Baburam: Numerical Methods, Pearson Education

10. Veerarajan, Numerical Methods, Tata McGraw Hill

Course Code: PCC-CS401

Course Title: Formal Language and Automata Theory

Credit: 3

1 Regular Languages and Finite Automata:

Deterministic finite automata (DFA) and Nondeterministic finite automata (NFA) NFA to DFA Conversion(with and without null moves), Equivalence of Finite State Machines, Minimization of Finite Automata, Moore and Mealy Machine, Merger Table, Merger Graph, Compatibility Graph, Finite memory definiteness, Testing Table Testing Graph, Introduction to Regular expressions. Conversion of Finite Automata to Regular Expression and Vice Versa. Regular grammars and equivalence with finite automata (Inter-conversion), Closure properties of regular languages, pumping lemma for regular languages. 12

2 Grammar:

Chomsky hierarchy of languages/Grammar. Introduction to Grammar. Construction of Grammar for a given language.

Context Free Grammar: Parse Tree, Derivation of Strings from Grammar, Ambiguity of Grammar, Removal of Ambiguity, Simplification of Context Free Grammar, CNF and GNF. 8

3 Pushdown automata and Context Free Language:

Deterministic and Non-deterministic pushdown automata (PDA) and equivalence with CFG, Acceptance of CFL by PDA (2 types). pumping lemma for context-free languages, Closure properties of CFLs. Relation of PDA and Parsing. Brief Introduction to Linear Bounded Automata (LBA) 10

4 Turing machines:

The basic model for Turing machines (TM), TM Design, Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, Church-Turing thesis, Universal Turing machine, Halting Problem. Decidability and Un-decidability. 10

Learning Resources:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.

3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.

4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.

5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.

6. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

Course Code: PCC-CS402

Course Title: Design & Analysis of Algorithms

Credit: 3

1 Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Master's theorem; Divide and Conquer algorithms – Merge Sort, Quick Sort, Finding lower bound of comparison-based sorting algorithms, Strassen's algorithm for multiplying matrices. 8

2 Fundamental Algorithmic Strategies: Brute-force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem solving, Bin Packing, Knapsack, TSP, Heuristics – characteristics and their application domains, KMP algorithm. 8

3 Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS), Disjoint Set Data Structures, Shortest paths algorithms, Minimum Spanning Tree, Topological sorting, Network Flow Problem. 6

4 Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard, Cook's theorem, Standard NP-complete problems and Reduction techniques. 10

5 Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE. 4

Learning Resources:

1. Introduction to Algorithms, 4th Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Algorithms, 4th Edition, Robert Sedgewick and Kevin Wayne, Princeton University.

3. Fundamental pf Algorithms – E. Horowitz et al.

4. Algorithm Design, 1st Edition, Jon Kleinberg and EvaTardos, Pearson.

5. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

6. Algorithms – A Creative Approach, 3rd Edition, UdiManber, Addison-Wesley, Reading, MA.

7. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing Housh (AICTE Recommended Textbook – 2018)

8. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai.

Course Code: PCC-CS403

Course Title: Database Management Systems

Credit: 3

1 Introduction

Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. 4

2 Entity-Relationship Model

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features. 6

3 Relational Model

Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database. 5

4 SQL and Integrity Constraints

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers. 6

5 Relational Database Design

Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF 8

6 Internals of RDBMS

Physical data structures, Query optimization : join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking. 6

7 File Organization & Index Structures

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree . 5

Learning Resources:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System CyberTech
6. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
7. Ullman JD., "Principles of Database Systems", Galgottia Publication.
8. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
9. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
10. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

Course Code: PCC-CS404

Course Title: Computer Networks

Credit: 3

1 Module I

Overview of Data Communication and Networking:

Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Physical Level:

Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network; 10

2 Module II

Data link Layer:

Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

Medium Access sub layer:

Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet(in brief); 10

3 Module III

Network layer:

Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, subnetting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6;.

Transport layer:

Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm, 10

4 Application Layer

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.

Modern topics:

ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief

Wireless LAN: IEEE 802.11, Introduction to blue-tooth. 6

Learning Resources:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas
7. Miller, Digital & Data Communication, Jaico
8. Shay, Understanding Data Communication & Network, Vikas
9. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education

10. Leon, Garica, Widjaja – "Communication Networks" – TMH
11. Walrand – "Communication Networks" – TMH.
12. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

Course Code: PCC-CS405

Course Title: Artificial Intelligence & Machine Learning Advanced

Credit: 3

Module 1: Recapitulation of Linear Algebra, Bayes Theorem, Expectation, Variance, Matrix Calculus – Numerical Optimization – Gradient Descent

Module 2: Linear Regression – Least Square Gradient Descent Method – Derivations – Goodness of Fit – Bias-Variance Trade off.

Module 3: Logistic Regression – Sigmoid – Gradient of Logistic Regression – Binary Cross Entropy cost function - Realization of Gates (AND, OR, XOR, NAND)

Module 4: Artificial Neural Networks – Multinomial Classification – One-Hot-Vector – Backpropagation – Derivations

Module 5: Introduction to Convolutional Neural Networks – Regularization - CNN architectures – LeNet – VGG Net – Google Net – ResNet. Image classification – Hyperparameter optimization – Transfer learning – case studies

Module 6: Introduction to Recurrent Neural Networks – Deep RNNs – Bi-RNNs – Long Short-Term Memory – Vanishing gradient

Module 7: Recap - Data preprocessing – Normalization – Feature Selection – Feature Reduction – PCA - local linear embedding, ISOmap, multidimensional scaling, Performance Evaluation of Classifiers – Cross Validation – Receiver Operating Characteristics Curve

Module 8: Lazy Learners – nearest neighbors – Decision Tree – CART – Ensemble Methods – Bagging – Boosting – Random Forest – Semi Supervised Learning

Module 9: Clustering – Partitioning Methods – K-means – K-medoids – Fuzzy Clustering – Hierarchical methods – Agglomerative Nesting (AGNES) – Performance Evaluation

Course Code: HSMC401

Course Title: Essential Studies for Professionals – IV

Credit : 2

1 GK & CA, Modern History& National Movement.Indian Geography at a glance (Physical, Regional & Economic) 3

2 Miscellaneous: calendar etc. capitals of countries, currency of countries, important dates, Sports football, hockey etc. recent events & awards too. 5

3 Important books & authors, Important Hydropower dams, atomic power plant s, important national parks, Minster & portfolio & constituencies, Population census, Persons in news - most famous, popular recent only, 4

4 Important dances & festivals of Indian states, International Head Quarters & world organization, Important president & pm elected from various countries 4

5 Important about banks like payment banks, small banks & license system, Awards, Sports, Books & author, National & International affairs. 4

Course Code: PCC-CS492

Course Title: Design & Analysis of Algorithms Lab

Credit: 1.5

1 Divide and Conquer Algorithm:

Implement Binary Search using Divide and Conquer approach, Implement Merge Sort using Divide and Conquer approach, Implement Quick Sort using Divide and Conquer approach, Find the Maximum and the Minimum element from a given array of integers using Divide and Conquer approach, Find the Median of two sorted arrays using Divide and Conquer approach, Find the Bitonic point in Bitonic sequence using Divide and Conquer approach, Implement the Multiplication of two matrices using Strassen's Divide and Conquer approach, Find the neighbors of the Median element using the partitioning strategy of Quick Sorting method.

Linear-time Sorting Algorithm:

Implement Count Sort, Implement Dictionary Sorting Strategy. 9

2 Dynamic Programming:

Implement the Coin-exchange problem using Dynamic Programming, Find the Minimum number of scalar multiplications needed for a given chain of matrices using Dynamic Programming, Implement the Single Source Shortest Paths problem for a given directed graph (Bellman-Ford algorithm), Implement the All-Pair Shortest Paths problem for a given directed graph (Floyd-Warshall algorithm), Implement the Traveling Salesman Problem using Held-Karp algorithm, Find the minimum edit distances to convert one string into another string using Dynamic Programming, Implement the 0-1 Knapsack problem using Dynamic Programming, Implement the Subset-Sum problem using Dynamic Programming. 12

3 Branch and Bound:

Implement the 15-Puzzle Problem using Branch and Bound algorithm.

Backtracking:

Implement the 8-Queen Problem using Backtracking, Implement the Graph Coloring Problem using Backtracking, Implement the Hamiltonian Problem using Backtracking. 6

4 Greedy Algorithm:

Implement the Fractional Knapsack Problem using greedy method, Implement the Job sequencing with deadlines using greedy method, Implement the Single Source Shortest Paths problem for a given directed graph (Dijkstra's algorithm), Implement the Minimum Cost

Spanning Tree using Prim's algorithm, Implement the Minimum Cost Spanning Tree using Kruskal's algorithm.

Fundamental Graph Algorithm:

Implement Breadth First Search (BFS), Implement Depth First Search (DFS), Find all Strongly Connected components of a given directed graph using Kosaraju's algorithm, Implement the Union-Find algorithm, Find the Max-Flow of a given Flow network using Ford-Fulkerson method.

String Matching Problem:

Implement the String Matching Problem using Knuth-Morris-Pratt algorithm. 9

Learning Resources:

1. Introduction to Algorithms, 4th Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Algorithms In A Nutshell, George T. Heineman, Gary Pollice and Stanley Selkow, O'Reilly.

3. Fundamental pf Algorithms – E. Horowitz et al.

4. Algorithm Design, 1st Edition, Jon Kleinberg and EvaTardos, Pearson.

5. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

6. Algorithms – A Creative Approach, 3rd Edition, UdiManber, Addison-Wesley, Reading, MA.

7. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing Housh (AICTE Recommended Textbook – 2018).

Course Code: PCC-CS493

Course Title: Database management Systems Lab

Credit: 1.5

Structured Query Language

1. **Creating Database**

- Creating a Database
- Creating a Table
- Specifying Relational Data Types
- Specifying Constraints
- Creating Indexes

Table and Record Handling

1. INSERT statement
2. Using SELECT and INSERT together
3. DELETE, UPDATE, TRUNCATE statements
4. DROP, ALTER statements

Retrieving Data from a Database

- The SELECT statement
- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
- Using Aggregate Functions
- Combining Tables Using JOINS
- Subqueries

Database Management

- Creating Views
- Creating Column Aliases
- Creating Database Users
- Using GRANT and REVOKE

Basics of PL/SQL & its implementations

Course Code: PCC-CS494

Course Title: Computer Networks Lab

Credit: 1.5

Description

- IPC (Message queue)
- NIC Installation & Configuration (Windows/Linux)
- Familiarization with
  - Networking cables (CAT5, UTP)
  - Connectors (RJ45, T-connector)
  - Hubs, Switches

- TCP/UDP Socket Programming
- Multicast & Broadcast Sockets

Implementation of a Prototype Multithreaded Server

- Implementation of
  - Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
  - Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
  - Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)
-

Course Code: PCC – CS495

Course Title: Artificial Intelligence & Machine Learning Advanced Laboratory

Credit : 2

Module 1:

1. Implementation of Decision Tree using scikit learn
2. Implementation of Random Forest using scikit learn
3. Implementation of Bagging method using scikit learn
4. Implementation of AdaBoost algorithm using scikit learn

Module 2:

5. Implementation of Ridge Regression using linear_model of scikit learn
6. Implementation of Elastic-Net using linear_model of scikit learn
7. Implementation of Lasso using linear_model of scikit learn
8. Implementation of Support Vector Regressor (with linear & non-linear kernel) using scikit learn

Module 3:

9. Implementation of unsupervised dimensionality reduction using principal component analysis in scikit learn
10. Implement Locally linear embedding (LLE) using scikit learn
11. Implement Isometric Mapping algorithm using scikit learn
12. Implementation of Multi-dimensional Scaling (MDS) using scikit learn
13. Implementation of t-distributed Stochastic Neighbor Embedding (t-SNE) algorithm in scikit learn

Module 4:

14. Implementation of Label Propagation using scikit learn
15. Implementation of Label Spreading using scikit learn

Module 5:

16. Implementation of an Image classifier using 2D Convolutional Neural Network using Tensorflow / Keras
17. Implementation of Long Short Term Memory network using Tensorflow / Keras

Module 6:

18. Familiarization with Confusion matrix based model evaluation metrics using Scikit learn
19. Familiarization with Regression model evaluation metrics using Scikit learn
20. Familiarization with Clustering model evaluation metrics using Scikit learn

Course Code: PCC – CS481

Course Title: Object Oriented Programming Using Java

Credit : 3

1 Introduction to Object-Oriented Thinking

• Difference between OOP and other conventional programming – advantages and disadvantages

- Class, object, message passing,
- encapsulation,
- inheritance,
- polymorphism
- Software Design
- Software Development Life Cycle 2

2 Object-Oriented Programming Constructs

- Class, Object,
- relationships among classes- association, dependency (use, call), aggregation, grouping, generalisation
- relationships among objects - instantiation, links
- meta-class
- Modelling with UML Class and Sequence Diagrams9

3 Designing for Reuse

- Good design principles e.g. Single Responsibility Principle (SRP). Don't Repeat Yourself (DRY) Principle.
- Interfaces and abstract classes.
- Loose coupling.
- Inheritance versus Delegation.

3

4 Basic concepts of Java programming

Advantages of Java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, for-each loop, array, creation of class, object, constructor, object class, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, variable length arguments, static block, variables & methods, nested & inner classes.

String Classes

String class, concept of string pool, concept of mutable and immutable string, basic methods of String class, StringBuffer class, basic methods of StringBuffer class, Introduction to StringBuilder class, basic methods of StringBuilder class, comparisons.

Basic of I/O operations

Command line argument, basic of I/O, different types of streams, basic stream classes, introduction to BufferedReader class, basic file handling, introduction to Scanner class.

9L

5 Reusability properties

Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords comparison between super and this, dynamic method dispatch, method hiding, object type casting, use of abstract classes & methods, interfaces.

Package

Introduction to package concept, Advantage of using package concept, basic inbuilt packages, package creation, different ways of importing packages, member access for packages

6L

6 Exception handling

Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, try with resources, creation of user defined exception classes.

Threading

Introduction to process, scheduling, context switching, difference between process and thread, basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

Swing

Advanced Topics: Basic concepts of AWT library, Creation of GUI using Swing library, Event Driven Programming (implementing ActionListener to multiple buttons, MouseListener, KeyListener interfaces), Painting (drawing objects) using AWT.

Generic class and Collection framework

Introduction to generic class, advantage of generic class user defined generic class & method, introduction to collection framework, advantages, different classes, iterator.

7L

Course Code: HSMC481

Course Title: Skill Development for Professional – IV

Credit: 1

1 Permutation & Combination. Probability- basic concepts of probability, different theorems & applications, binomial, poison & normal Distributions. Geometry- Concept of different shapes like triangle, quadrilateral, rectangle, square, circle etc. different theorems & their applications. Mensuration- Formulae on triangles, square, Rhombus, parallelogram, sphere, circle, cone, pyramid etc. Application based problem solving. Coordinate Geometry- Locus, Straight lines, Circle etc. 6

2 1) Seating Arrangement

a) Circular seating arrangement

b) Square seating Arrangement

c) Line Arrangement, Calendar And Clock, Miscellaneous Problems 5

3 1) Sentence Corrections

2)Fill the blanks with appropriate words/articles/preposition/ verbs/adverbs/conjunction.

3) Reading Comprehension (Advance Level) 4)Vocabulary 5

4 Sentence Corrections, Fill the blanks with appropriate words/articles/preposition/verbs/adverbs/conjunction.

Reading Comprehension (Advance Level) Vocabulary

News paper reading: The Hindu & Economic Times. 4

3rd Year 5th Semester

Course Code: PCC-CS501

Course Title: Software Engineering

Credit: 3

1 Software Engineering –Objectives, Definitions ,Software Process models - Waterfall Model , Prototype model, RAD, Evolutionary Models ,Incremental, Spiral

Software Project Planning- Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model. 8

2 Structured Analysis , Context diagram and DFD, Physical and Logical DFDs ,Data Modelling, ER diagrams, Software Requirements Specification 5

3 Design Aspects :Top-Down And Bottom-Up design; Decision tree, decision table and structured English, Structure chart, Transform analysis Functional vs. Object- Oriented approach. 4

4 Unified Modelling Language

Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram 6

5 Coding & Documentation – Structured Programming, Modular Programming, Module Relationship- Coupling, Cohesion, OO Programming, Information Hiding, Reuse, System Documentation.

Testing – Levels of Testing, Integration Testing, System Testing.

Software Quality, Quality Assurance, Software Maintenance, Software Configuration Management, Software Architecture. 15

Learning Resources:

1. Software Engineering : A practitioner's approach– Pressman(TMH)
2. Software Engineering- Pankaj Jalote (Wiley-India)
3. Software Engineering- Rajib Mall (PHI)
4. Software Engineering –Agarwal and Agarwal (PHI)

Course Code: PCC-CS502

Course Title: Operating Systems

Credit: 3

1 Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel. 4

2 Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls. 4

3 Processes [3L]: Concept of processes, process scheduling, operations on processes, co-operating processes, inter-process communication.

Threads [2L]: overview, benefits of threads, user and kernel threads.

CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock. 16

4 Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Disk Management [4L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks. 20

5 Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption. 4

Learning Resources:

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley

Course Code: PCC-CS503
Course Title: Cloud Computing & IoT
Credit: 3

1 Definition of Cloud Computing:
Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model
Characteristics of Cloud Computing – a shift in paradigm
Benefits and advantages of Cloud Computing
4

2 A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients
4

3 IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos
PaaS – Basic concept, tools and development environment with examples
SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform
Identity as a Service (IDaaS)
Compliance as a Service (CaaS)
2

4 Concepts of Abstraction and Virtualization
Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D)
4

5 Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing
Hypervisors: Virtual machine technology and types, VMware vSphere
Machine Imaging (including mention of Open Virtualization Format – OVF)
6

6 Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance 2

7 Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development
Use of PaaS Application frameworks 2

8 Use of Google Web Services
Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.
Use of Amazon Web Services
Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services
Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

4

9 Cloud Management
An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)
Concepts of Cloud Security
Cloud security concerns, Security boundary, Security service boundary
Overview of security mapping
Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance
Identity management (awareness of Identity protocol standards)

4

10 Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs
Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs
Cloud-based Storage: Cloud storage definition – Manned and Unmanned
Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services

4

Course Code: **Course Code:** PEC-CS501

Course Title: Deep Learning

Credit: 3

1.Fundamentals of Neural Network & Deep Learning:
Challenges in shallow network; Motivation for deep neural network, Different deep neural network architectures – Perceptron, Feedforward network, etc. Forward and backward propagation, Gradient Descent and related problems, Regularization, Batch normalization, Optimization algorithms (Adam's, RMSprop, etc.), Hyperparameters

2.Convolutional Neural Network:
Foundational concepts of CNN,Building a CNN architecture,Popular CNN architectures – LeNet, AlexNet, ResNet, CNN applications

3. Recurrent Neural Network:
Sequence data,Architecture of RNN,Long Short Term Memory (LSTM),Bi-directional LSTM,Gated Recurrent Unit (GRU),Applications of RNN

4.Important deep learning frameworks:
Tensorflow 2.0, Keras,PyTorch,Theano,Caffe

Learning Resources:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning, The MIT Press.
2. Fundamentals of Deep Learning – by Nikhil Buduma (O'Reilly).
3. Deep Learning – A practitioner's approach – by Josh Patterson & Adam Gibson (O'Reilly).

Course Code:PEC-CS501

Course Title: Cyber Security

Credit: 3

1 Introduction to Cyber Security
Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.
4

2 Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management. 4

3 Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. 4

4 Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. 4

5 Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. 4

6 Cyberspace and the Law
Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.
4

7 Cyber Forensics
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.
4

Course Code: PEC-CS502

Course Title: Soft Computing

Credit: 3

1 Introduction to Soft Computing

- Concept of computing systems.
- "Soft" compiting versus "Hard" computing
- Characteristics of Soft computing
- Some applications of Soft computing techniques 4

2 Fuzzy logic

- Introduction to Fuzzy logic.
- Fuzzy sets and membership functions.
- Operations on Fuzzy sets.
- Fuzzy relations, rules, propositions, implications and inferences.
- Defuzzification techniques.
- Fuzzy logic controller design.
- Some applications of Fuzzy logic. 4

3 Genetic Algorithms

- Concept of "Genetics" and "Evolution" and its application to proablistic search techniques
- Basic GA framework and different GA architectures.
- GA operators: Encoding, Crossover, Selection, Mutation, etc.
- Solving single-objective optimization problems using GAs.

6

4 Multi-objective Optimization Problem Solving

- Concept of multi-objective optimization problems (MOOPs) and issues of solving them.
- Multi-Objective Evolutionary Algorithm (MOEA).
- Non-Pareto approaches to solve MOOPs
- Pareto-based approaches to solve MOOPs
- Some applications with MOEAs. 6

5 Artificial Neural Networks

- Biological neurons and its working.
- Simulation of biolgical neurons to problem soloving.
- Different ANNs architectures.

- Trainging techniques for ANNs.
- Applications of ANNs to solve some real life problems. 6

Learning Resources:

1. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
3. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press, 1998.
4. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
5. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
6. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
7. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
8. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
9. Soft Computing, D. K. Pratihar, Narosa, 2008.
10. Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.
11. Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.

Course Code: PEC-CS502

Course Title: Cyber Law, IPR & Ethics
Credit: 3

1.Introduction to cyber law Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Cyber Laws of other countries: EU GDPR, PIPEDA (Canada), etc.

2.Information technology Act Overview of IT Act, 2000, Amendments in 2008/2013 and Limitations of ITAct, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Li-ability

3.Cyber law and related Legislation Patent Law, Trademark Law, Copyright, Software Copyright or Patented, Do- main Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant

SectionsofIndianEvidenceAct,RelevantSectionsofBankersBookEvidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank ofIndiaAct,LawRelatingToEmployeesAndInternet,AlternativeDisputeRes olution, Online Dispute Resolution (ODR).

4.Electronic Business and legal issues Legal issues in Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security

5.Application area Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends

Learning Resources:

1.Cyber Law & Cyber Crimes By Advocat Prashant Mali; Snow White publications, Mumbai
2. Cyber Law in India by Farooq Ahmad; Pioneer Books
3. Information Technology Law and Practice by Vakul Sharma; Universal Law Publishing Co. Pvt. Ltd.
4. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
5. Guide to Cyber and E – Commerce Laws by P.M. Bukshi and R.K. Suri; Bharat Law

Course Code: HSMC501
Course Title: Principles of Management
Credit: 2

1 Basic concepts of management: Definition – Essence, Functions, Roles, Level. 2
2 Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness. 4
3 Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.
Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship. 6
4 Leadership: Concept, Nature, Styles.
Decision making: Concept, Nature, Process, Tools & techniques.
Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control. 6
5 Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management.
Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS. 6

Course Code: HSMC502
Course Title: Essential Studies for Professionals – V
Credit: 2

ADVANCE PROFESSIONAL KNOWLEDGE-1

Module-1: Programming in C.

Module-2: Programming and Data Structures

Module-3: Digital Logic Design & Computer Organisation & Architecture

Module-4: Formal Language & Automata Theory

Module-5: Database Management Systems

Course Code: PCC-CS591
Course Title: Software Engineering Laboratory
Credit: 1.5

Part-A:

Basics of C++ using OOPs concept, implementation of inheritance, polymorphism, friend function, perform various kind of effort estimation, solving of function point metrices.

Part-B:

Development of requirements specification, function-oriented design using SA/SD, object-oriented design using UML, test case design, implementation of CRUD based project using C++ (along with file management system or database management system) and testing. Use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle.

References

1. Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India.
2. Pankaj Jalote, An integrated approach to Software Engineering, Springer/Narosa.
3. Roger S. Pressman, Software Engineering: A practitioner's approach, McGraw Hill.
4. Ian Sommerville, Software Engineering, Addison-Wesley.

Course Code: PCC-CS592
Course Title: Operating Systems Laboratory
Credit: 1.5

Shell programming [6P]: creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).

2. **Process [6P]**: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.

3. **Signal [9P]**: signal handling, sending signals, signal interface, signal sets.

4. **Semaphore [6P]**: programming with semaphores (use functions semctl, semget, semop, set_semvalue,

del_semvalue, semaphore_p, semaphore_v).

5. **POSIX Threads [9P]**: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit,

pthread_attr_init, pthread_cancel)

6. **Inter-process communication [9P]**: pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO)

Course Code: PCC-CS593
Course Title: Cloud Computing & IoT Lab
Credit: 1.5

1. Creating a Warehouse Application in SalesForce.com.
2. Creating an Application in SalesForce.com using Apexprogramming Language.
3. Implementation of SOAP Web services in C#/JAVAApplications.
4. Implementation of Para-Virtualization using VM Ware'sWorkstation/ Oracle's Virtual Box and Guest O.S.
5. Installation and Configuration of Hadoop.
6. Create an application (Ex: Word Count) using HadoopMap/Reduce.
7. Case Study: PAAS(Facebook, Google App Engine)
8. Case Study: Amazon Web Services.
9. Recapitulation of Python.
10. Study and Install IDE of Arduino and different types of Arduino.
11. Write program using Arduino IDE for Blink LED.
12. Write Program for RGB LED using Arduino.
13. Study the Temperature sensor and Write Program foe monitor temperature usingArduino.
14. Study and Implement RFID, NFC using Arduino.
15. Study and implement MQTT protocol using Arduino.
16. Study and Configure Raspberry Pi.
17. WAP for LED blink using Raspberry Pi.
18. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.

Course Code: HSMC582
Course Title: Skill Development for Professionals – V
ADVANCE MATHEMATICS-2:

Module-1

Probability:

Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Baye's theorem.

Module-2

5 Mock Tests on the syllabus of Aptitude Tests.

Learning Materials-

Fastrack objective Arithmetic: Arihant
Quantitative aptitude for Competitive exam (4th Edition): TATA Mc Graw Hill
Quantitative aptitude for Competitive exam (3rd Edition): PEARSON
Engineering mathematics-Pearson
GATE Mathematics- Willey/McGraw hill

3rd Year 6th Semester

Course Code: PCC-CS601

Course Title: Compiler Design

Credit: 3

Proposed Syllabus:

Module I

Introduction to Compiling [2L]

Compilers, Analysis-synthesis model , The phases of the compiler, Cousins of the compiler.

Lexical Analysis [5L]

The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module II

Syntax Analysis [8L]

The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

Syntax directed translation [4L]

Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Module III

Type checking [3L]

Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

Run time environments [4L]

Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

Module IV

Intermediate code generation [3L]

Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code optimization [4L]

Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations [3L]

Issues in the design of code generator, a simple code generator, Register allocation & assignment.

Learning Resources:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" – PHI
3.Tremblay and Sorenson Compiler Writing-McgrawHill International .
4. Chattopadhyay , S- Compiler Design (PHI)

Course Code: PCC-CS602

Course Title: Network Security & Cryptography

Credit: 3

Proposed Syllabus:

1. Introduction and Mathematical Foundations

Introduction to cryptography, Overview on Modern Cryptography, Number Theory, Probability and Information Theory

2. **Classical Cryptosystems**

Cryptanalysis of Classical Cryptosystems
Shannon's Theory: I
Shannon's Theory: II
Shannon's Theory: III

3.**Symmetric Key Ciphers**
Modern Block Ciphers (DES)
Modern Block Cipher (AES)
Modern Block Cipher (AES) contd.

3.**Cryptanalysis of Symmetric Key Ciphers**
Linear Cryptanalysis
Differential Cryptanalysis
Other Cryptanalytic Techniques
Overview on S-Box Design Principles
Modes of operation of Block Ciphers

4.**Stream Ciphers and Pseudorandomness**
Stream Ciphers
Pseudorandom functions

5.Hash Functions and MACs Hash functions:
The Merkle Damgard Construction
Message Authentication Codes (MACs)

6.**Asymmetric Key Ciphers:**
Construction and Cryptanalysis
More Number Theoretic Results
The RSA Cryptosystem
Primality Testing
Factoring Algorithms
Other attacks on RSA and Semantic Security of RSA
The Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm
The ElGamal Encryption Algorithm
Cryptanalysis of DLP

7.**Digital Signatures**
Signature schemes: I
Signature schemes: II

8.**Modern Trends in Asymmetric Key Cryptography**
Elliptic curve based cryptography: I
Elliptic curve based cryptography: II

9.**Network Security Secret Sharing Schemes**
A Tutorial on Network Protocols, Kerberos
Pretty Good Privacy (PGP)
Secure Socket Layer (SSL)
Intruders and Viruses
Firewalls

Course Code: PEC-CS601/ OEC-CS601

Course Title: Big Data Analytics

Credit: 3

1. Introduction To Big Data And Hadoop
Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

2. Hdfs(Hadoop Distributed File System)
The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

3.Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

4.Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

5.Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Learning Resources:

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Course Code: PEC-CS601

Course Title: Embedded Systems

Credit: 3

1. Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice.
Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency.
Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

2. Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them. Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them.

3. Embedded Serial communication
Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, 10 CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network

4. Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

Learning Resources:

1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems : Rajkamal (TMH)
4. Embedded Systems : L. B. Das (Pearson)

Course Code: PEC-CS602

Course Title: Natural Language Processing
Credit: 3

1.Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

2.Word Level Analysis:
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models

3.Syntactic Analysis:
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

4.Semantics And Pragmatics : Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

5.Discourse Analysis And Lexical Resources :
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer,

Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Learning Resources:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

2.Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly Media, 2009

Course Code: PEC-CS602/ OEC-CS601

Course Title: Blockchain Technology
Credit: 3

1.Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries,Byzantine Generals problem,Consensus algorithms and their scalability problems,Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

2. Basic Distributed Computing: Atomic Broadcast, Consensus, Byzantine Models of fault tolerance

3. Basic Crypto primitives:
Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems.

4. Blockchain 1.0:
Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.

5. Blockchain 2.0:
Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts.

6. Blockchain 3.0 :
Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain
7. Privacy, Security issues in Blockchain: Blockchain:
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these

Learning Resources:

1. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.

2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

Course Code: HSMC601

Course Title: Management - II (Software Project Management)

Credit: 2

1. UNIT I : PROJECT EVALUATION AND PROJECT PLANNING

Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning. (9L)

2. UNIT II : PROJECT LIFE CYCLE AND EFFORT ESTIMATION

Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern. (9L)

3. UNIT III : ACTIVITY PLANNING AND RISK MANAGEMENT

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules. (9L)

Learning Resources:

1.Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

2.Robert K. Wysocki "Effective Software Project Management" – Wiley Publication,2011.

3. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.

4. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013

Course Code: HSMC602

Course Title: Essential Studies for Professionals – VI

Credit: 2

As per GATE Syllabus

Course Code: PCC-CS691

Course Title: Compiler Design Laboratory

Credit: 3

1.Implementation of Symbol Table
2. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)
3. Implementation of Lexical Analyzer using Lex Tool
4. Generate YACC specification for a few syntactic categories.
a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /.
b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
c)Implementation of Calculator using LEX and YACC
5. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.
6. Implement type checking
7. Implement control flow analysis and Data flow Analysis
8. Implement any one storage allocation strategies(Heap,Stack,Static)
9. Construction of DAG
10. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using a 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also simple addressing modes are used.

4th Year 7th Semester

Course Code: BSC701
Course Title: Biology
Credit: 3

Proposed Syllabus:

1.Introduction: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

2.Classification: Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus
3.Genetics: Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how

genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

4.Biomolecules: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

5.Enzymes: Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

6.Information Transfer: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

7.Macromolecular analysis: Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

8.Metabolism: Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Learning Resources:

5. 9.Microbiology: Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.
   Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
6. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
7. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

Course Code: BSC702
Course Title: Environmental Sciences
Credit: 1

Proposed Syllabus:

1.Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L) Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. (2L) Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L) Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)

2.Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. (1L) Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.(2L) Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L) Biodiversity-types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)

3.Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L) Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L) Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L) Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L) Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L) Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. (1L) Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)

4. Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L) River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L) Lake: Eutrophication [Definition, source and effect]. (1L) Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition.

(2L) Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)

5.Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L) River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L) Lake: Eutrophication [Definition, source and effect]. (1L) Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L) Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)

Learning Resources:

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)

2. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd.,1991.

3. De, A. K., "Environmental Chemistry", New Age International

Course Code: PEC-CS701
Course Title: Computer Vision
Credit: 3

1.Camera Geometry: Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations; Transformations in 3D: translation, rotation about X,Y,Z axis, rotation about arbitrary axis, 3D affine, number of degrees of freedom; Composition of transformations in 2D and 3D with examples; concept og homogeneous coordinates in 2D and 3D; Concept of pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera; Concept of pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera; Weak perspective projection and orthographic projection;Concept of image coordinate system and camera coordinate system; intrinsic camera parameters; Concept of world coordinate system and its relationship to camera and image coordinate systems; extrinsic camera parameters; Concept of camera calibration and basic aim of camera calibration; Concept of camera calibration and basic aim of camera calibration;Algorithm for derivation of camera matrix (size 3 x 4) due to Faugeras and Toscani; derivation of camera parameters from the camera matrix;Motivation for camera calibration - implications for 3D reconstruction using two calibrated cameras; Perspective invariant - cross-ratio; Perspective invariant - cross-ratio - proof of cross-ratio being a perspective invariant; Use of cross-ratio and vanishing points in metrology - two different scenarios; Introduction to planar homography; Derivation for planar homography; algorithm for homography estimation given N pairs of corresponding points from two images of a

planar scene; Another camera calibration algorithm; orthocenter theorem for vanishing points; Clarifications about homography

2.Image Alignment: Problem statement: physically and digitally corresponding points

- Motion models and degrees of freedom; non-rigid/deformable/non-parametric image alignment
- Control point based image alignment using least squares - derivation for pseudo-inverse
- Introduction to the SIFT algorithm
- Applications of image alignment: Google art project
- Forward and reverse image warping - bilinear and nearest-neighbor interpolation
- Image alignment using image similarity measures: mean squared error, normalized cross-correlation
- Concept of field of view in image alignment using image similarity measures
- Monomodal and multimodal image alignment
- Concept of joint histograms and behaviour of joint histograms in multi-modal image alignment
- Concept of joint histograms and behaviour of joint histograms in multi-modal image alignment
- Concept of entropy and joint entropy, algorithm for multimodal registration by minimizing joint entropy
- Aspects of image registration: 2D/3D, motion model, monomodal or multimodal
- Application scenarios for image alignment: template matching, video stabilization, panorama generation, face recognition, 3D to 2D alignment
- Least squares algorithm for determining orthonormal transformation between corresponding pairs of points: the orthogonal procrustes problem

3 Robust Methods in Computer Vision:

- Least squares problems and their relation to the Gaussian distribution on the noise
- Examples of outliers in computer vision
- Explanation of why the Gaussian distribution is unsuited to handling outliers
- Introduction to the Laplacian distribution
- Introduction to the Laplacian distribution and Generalized Gaussian distribution
- The importance of heavy-tailed distributions in robust statistics
- Mean versus median: L2 fit versus L1 fit
- Least median of squares algorithm (LMedS)
- RanSaC (random sample consensus) algorithm
- Use of RanSaC in robust determination of planar homographies
- Variants of RanSaC

4 Structure from Motion:

- Motion as a cue to inference of 3D structure from images
- Motion factorization algorithm by Tomasi and Kanade for inference of (sparse) 3D structure of a fixed object being observed by a moving orthographic camera (or a rigidly moving object, being observed by a fixed orthographic camera)
- Aspects of the above algorithm: Eckhart Young theorem in SVD, metric constraints for inference of motion parameters and 3D structure

  SVD: concept of SVD as a weighted summation of rank-one matrices

5 Optical Flow:

- Dealing with the aperture problem: regularization

- Horn and Shunck method: algorithm using discrete formulation, steps of Jacobi's method for matrix inversion, and comments about limitations
- Lucas-Kanade algorithm for optical flow
- Multi-scale Lucas-Kanade algorithm
- Comparison of Horn-Shunck and Lucas-Kanade algorithms
- Applications of optical flow

6 Feature Point Tracking:

- Feature point tracking: Kanade-Lucas-Kanade tracker
- Motion models: patch-wise translation and patch-wise affine
- Concept of a good feature point based on saliency (similar to criteria in Lucas-Kanade optical flow algorithm)
- Tracking of salient feature points: using translation and affine models
- Some results of KLT tracker
- Applications of feature point tracking: mosaicing, video stabilization, structure from motion

7 Adaboost

- Machine learning 101 jargon
- Outline of Adaboost algorithm for binary classification - weak and strong classifiers
- Concept of weight of weak classifier, weight of sample point in Adaboost
- Concept of family of weak classifiers
- Theory behind Adaboost: objective function for Adaboost, and Adaboost as coordinate descent on this objective function
- Derivation of weights of weak classifiers and weights of training samples
- Comments on the generalization error of Adaboost
- Adaboost for face detection
- Computation of Haar-like features
- Concept of classifier cascade for pruning away negative samples, concept of false positive rate and detection rate
- Concept of (binocular geometric) stereo, stereo baseline, stereo disparity
- Simplest case of stereo with aligned coordinate systems of the two cameras: inverse relation between depth and disparity
- Parameters of a stereo system
- Epipolar geometry: epipolar plane, left and right epipoles, left and right epipolar lines
- Fully calibrated stereo with unaligned coordinate systems
- Essential and fundamental matrices in a stereo system; eight point algorithm

Learning Resources:

1. "Introductory Techniques for 3D Computer Vision", Emanuele Trucco and Alessandro Verri, Prentice Hall.

2. Robot Vision, by B. K. P. Horn, MIT Press (Cambridge).

3. Computer Vision: Algorithms and Applications, by Richard Szeliski

4. Computer Vision: A Modern Approach, Forsyth and Ponce, Pearson Education.

Course Code: PEC-CS701
Course Title: Digital Forensics

Credit: 3

1.Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

2.Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

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

4.Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

5.Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

Learning Resources:

1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
3. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Course Code: OEC-CS701
Course Title: Cyber Security
Credit: 3

1. Introduction to Cyber Security
Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

2.Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

3.Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

4.Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

5.Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

6.Cyberspace and the Law
Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

7.Cyber Forensics
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Learning Resources:

1. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", Prentice Hall, 2008.

2. Joseph M Kizza, "Computer Network Security", Springer Verlag, 2005

3. Thomas Calabres and Tom Calabrese, "Information Security Intelligence: Cryptographic Principles & Application", Thomson Delmar Learning, 2004.

Course Code: OEC-CS701
Course Title: Deep Learning
Credit: 3

1.Fundamentals of Neural Network & Deep Learning:
Challenges in shallow network; Motivation for deep neural network, Different deep neural network architectures – Perceptron, Feedforward network, etc. Forward and backward propagation, Gradient Descent and related problems, Regularization, Batch normalization, Optimization algorithms (Adam's, RMSprop, etc.), Hyperparameters

2.Convolutional Neural Network:
Foundational concepts of CNN,Building a CNN architecture,Popular CNN architectures – LeNet, AlexNet, ResNet, CNN applications

3. Recurrent Neural Network:

Sequence data,Architecture of RNN,Long Short Term Memory (LSTM),Bi-directional LSTM,Gated Recurrent Unit (GRU),Applications of RNN

4.Important deep learning frameworks:
Tensorflow 2.0, Keras,PyTorch,Theano,Caffe

Learning Resources:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning, The MIT Press.
2. Fundamentals of Deep Learning – by Nikhil Buduma (O'Reilly).
3. Deep Learning – A practitioner's approach – by Josh Patterson & Adam Gibson (O'Reilly).

Course Code: OEC-CS702
Course Title: Cyber Law, IPR & Ethics
Credit: 3

1.Introduction to cyber law Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Cyber Laws of other countries: EU GDPR, PIPEDA (Canada), etc.

2.Information technology Act Overview of IT Act, 2000, Amendments in 2008/2013 and Limitations of ITAct, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Li-ability

3.Cyber law and related Legislation Patent Law, Trademark Law, Copyright, Software Copyright or Patented, Do- main Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant SectionsofIndianEvidenceAct,RelevantSectionsofBankersBookEvidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank ofIndiaAct,LawRelatingToEmployeesAndInternet,AlternativeDisputeRes olution, Online Dispute Resolution (ODR).

4.Electronic Business and legal issues Legal issues in Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security

5.Application area Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends

Learning Resources:

1.Cyber Law & Cyber Crimes By Advocat Prashant Mali; Snow White publications, Mumbai
2. Cyber Law in India by Farooq Ahmad; Pioneer Books
3. Information Technology Law and Practice by Vakul Sharma; Universal Law Publishing Co. Pvt. Ltd.
4. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
5. Guide to Cyber and E – Commerce Laws by P.M. Bukshi and R.K. Suri; Bharat Law House, New Delhi

Course Code: OEC-CS702
Course Title: Natural Language Processing
Credit: 3

1.Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

2.Word Level Analysis:
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models

3.Syntactic Analysis:
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

4.Semantics And Pragmatics : Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

5.Discourse Analysis And Lexical Resources :
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Learning Resources:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly Media, 2009.

Course Code: HSMC701
Course Title : Humanities - II (Economics & Financial Accounting)

Credit: 2

1.Basic concepts of management: Definition – Essence, Functions, Roles, Level.

2.Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.

3.Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.
Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship.

4.Leadership: Concept, Nature, Styles.
Decision making: Concept, Nature, Process, Tools & techniques.
Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.

5.Nature of accounting; Users of accounting information; Qualitative characteristics of accounting information. • Double entry book keeping system – Basic accounting equation, meaning of assets, liabilities, equity, revenue and expenses. Accounting Cycle - Recording of transaction: Journal, Ledger and preparation of Trial Balance. • Bases of accounting; cash basis and accrual basis. • Basic concepts and conventions: entity, money measurement, going concern, cost, realisation, accruals, periodicity, consistency, prudence (conservatism), materiality, matching and full disclosures.

6.Financial accounting standards: concept, benefits, procedure for issuing accounting standards in India. Need for a global standard, IFRS (concept only).

Learning Resources:

1. Management: Principles, Processes & Practices – Bhat, A & Kumar, A (OUP).
2. Essentials for Management – Koontz, Revised edition, Tata McGraw Hill (TMH)
3. Management – Stoner, James A. F. (Pearson)
4. Management - Ghuman, Tata McGraw Hill(TMH)
5. Financial Accounting, McGraw Hill, Hanif & Mukherjee.
6. Advanced Accountancy Vol. I, S Chand- Sukla, Grewal, Gupta.

Course Code: HSMC702
Course Title : Essential Studies for Professionals - VII
Credit: 2

As per GATE Syllabus

4th Year 8th Semester

Course Code: PCC-CS801
Course Name: Quantum Computing
Credit: 3

Module No	Module Details	Contact Hours
1	**Introduction to Quantum Computation:** Quantum bits, Bloch sphererepresentation of a qubit, multiple qubits.	**2**
2	**Background Mathematics and Physics:** Hilber space, Probabilities andmeasurements, entanglement, density operators and correlation, basics ofquantum mechanics, Measurements in bases other than computational basis.	**8**
3	**Quantum Circuits:** single qubit gates, multiple qubit gates, design of quantum circuits.	**6**
4	**Quantum Information and Cryptography:** Comparison between classical andquantum information theory. Bell states. Quantum teleportation. QuantumCryptography, no cloning theorem.	**6**
5	**Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.	**10**
6	**Noise and error correction:** Graph states and codes, Quantum error correction,fault-tolerant computation.	**10**

Suggested Books:

1. Nielsen M. A., **Quantum Computation and Quantum Information**,Cambridge University Press.
2. Benenti G., Casati G. and Strini G., **Principles of Quantum Computation and Information**, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., **An Introduction to Quantum Computing Algorithms**

Course Code: OEC-CS801
Course Name: Digital Forensics
Credit : 3

Module No	Module Details	Contact Hours
1	Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.	3
2	Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.	4
3	Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.	7
4	Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.	7
5	Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.	8

Suggested Books:

4. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
5. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
6. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Course Code: OEC-CS801
Course Name: Computer Vision

Module No	Module Details	Contact Hours
1	**Camera Geometry:** Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations; Transformations in 3D: translation, rotation about X,Y,Z axis, rotation about arbitrary axis, 3D affine, number of degrees of freedom; Composition of transformations in 2D and 3D with examples; concept og homogeneous coordinates in 2D and 3D; Concept of pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera; Concept of pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera; Weak perspective projection and orthographic projection;Concept of image coordinate system and camera coordinate system; intrinsic camera parameters; Concept of world coordinate system and its relationship to camera and image coordinate systems; extrinsic camera parameters; Concept of camera calibration and basic aim of camera calibration; Concept of camera calibration and basic aim of camera calibration;Algorithm for derivation of camera matrix (size 3 x 4) due to Faugeras and Toscani; derivation of camera parameters from the camera matrix;Motivation for camera calibration - implications for 3D reconstruction using two calibrated cameras; Perspective	4

invariant - cross-ratio; Perspective invariant - cross-ratio - proof of cross-ratio being a perspective invariant; Use of cross-ratio and vanishing points in metrology - two different scenarios; Introduction to planar homography; Derivation for planar homography; algorithm for homography estimation given N pairs of corresponding points from two images of a planar scene; Another camera calibration algorithm; orthocenter theorem for vanishing points; Clarifications about homography

2	**Image Alignment:** Problem statement: physically and digitally corresponding points	5

- Motion models and degrees of freedom; non-rigid/deformable/non-parametric image alignment
- Control point based image alignment using least squares - derivation for pseudo-inverse
- Introduction to the SIFT algorithm
- Applications of image alignment: Google art project
- Forward and reverse image warping - bilinear and nearest-neighbor interpolation
- Image alignment using image similarity measures: mean squared error, normalized cross-correlation
- Concept of field of view in image alignment using image similarity measures
- Monomodal and multimodal image alignment
- Concept of joint histograms and behaviour of joint histograms in multi-modal image alignment
- Concept of joint histograms and behaviour of joint histograms in multi-modal image alignment
- Concept of entropy and joint entropy, algorithm for multimodal registration by minimizing joint entropy
- Aspects of image registration: 2D/3D, motion model, monomodal or multimodal
- Application scenarios for image alignment: template matching, video stabilization, panorama generation, face recognition, 3D to 2D alignment
- Least squares algorithm for determining orthonormal transformation between corresponding pairs of points: the orthogonal procrustes problem

3	**Robust Methods in Computer Vision:**	3

- Least squares problems and their relation to the Gaussian distribution on the noise
- Examples of outliers in computer vision
- Explanation of why the Gaussian distribution is unsuited to handling outliers
- Introduction to the Laplacian distribution
- Introduction to the Laplacian distribution and Generalized Gaussian distribution
- The importance of heavy-tailed distributions in robust

statistics
- Mean versus median: L2 fit versus L1 fit
- Least median of squares algorithm (LMedS)
- RanSaC (random sample consensus) algorithm
- Use of RanSaC in robust determination of planar homographies
- Variants of RanSaC

4 **Structure from Motion:** **3**

- Motion as a cue to inference of 3D structure from images
- Motion factorization algorithm by Tomasi and Kanade for inference of (sparse) 3D structure of a fixed object being observed by a moving orthographic camera (or a rigidly moving object, being observed by a fixed orthographic camera)
- Aspects of the above algorithm: Eckhart Young theorem in SVD, metric constraints for inference of motion parameters and 3D structure
- SVD: concept of SVD as a weighted summation of rank-one matrices

5 **Optical Flow:** **2**

- Dealing with the aperture problem: regularization
- Horn and Shunck method: algorithm using discrete formulation, steps of Jacobi's method for matrix inversion, and comments about limitations
- Lucas-Kanade algorithm for optical flow
- Multi-scale Lucas-Kanade algorithm
- Comparison of Horn-Shunck and Lucas-Kanade algorithms
- Applications of optical flow

6 **Feature Point Tracking:** **3**

- Feature point tracking: Kanade-Lucas-Kanade tracker
- Motion models: patch-wise translation and patch-wise affine
- Concept of a good feature point based on saliency (similar to criteria in Lucas-Kanade optical flow algorithm)
- Tracking of salient feature points: using translation and affine models
- Some results of KLT tracker
- Applications of feature point tracking: mosaicing, video stabilization, structure from motion

7 Adaboost

- Machine learning 101 jargon
- Outline of Adaboost algorithm for binary classification - weak and strong classifiers
- Concept of weight of weak classifier, weight of sample point in Adaboost
- Concept of family of weak classifiers
- Theory behind Adaboost: objective function for Adaboost, and Adaboost as coordinate descent on this objective function
- Derivation of weights of weak classifiers and weights of training samples
- Comments on the generalization error of Adaboost
- Adaboost for face detection
- Computation of Haar-like features
- Concept of classifier cascade for pruning away negative samples, concept of false positive rate and detection rate
- Concept of (binocular geometric) stereo, stereo baseline, stereo disparity
- Simplest case of stereo with aligned coordinate systems of the two cameras: inverse relation between depth and disparity
- Parameters of a stereo system
- Epipolar geometry: epipolar plane, left and right epipoles, left and right epipolar lines
- Fully calibrated stereo with unaligned coordinate systems
- Essential and fundamental matrices in a stereo system; eight point algorithm

Learning Materials and Textbooks

- Lecture slides that will be regularly posted
- "Introductory Techniques for 3D Computer Vision", Emanuele Trucco and Alessandro Verri, Prentice Hall.
- Robot Vision, by B. K. P. Horn, MIT Press (Cambridge).
- Computer Vision: Algorithms and Applications, by Richard Szeliski (freely downloadable!)
- Computer Vision: A Modern Approach, Forsyth and Ponce, Pearson Education.

****MAR : A student has to do following things to achieve MAR (Mandatory Additional Requirements) points :**

1. **The Student should engage herself / himself in different co-curricular activities outside the curriculum.**
2. **Should join different types of clubs, organize workshops, seminars, make products, remain active in outer society.**
3. **Participate in tech fests, cultural fests, various activities, etc.**