IKG Punjab Technical University

Syllabus (3rd- 8th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

ELECTRONICS AND COMMUNICATION ENGINEERING

Scheme & Syllabus

2019 and onwards

Main Campus Kapurthala

Head
Department of Electronics & Communication Engineering
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Structure of Distribution of credits Electronics & Communication Engineering Program as per AICTE Model Curriculum 2018:

Sr. No.	Category	Suggested Breakup of Credits (Total 160)
1	Humanities and Social Science including Management courses	12*
2	Basic Sciences courses	25*
3	Engineering Science courses-including workshop, drawing, basics of electrical/mechanical/computer etc.	24*
4	Professional Core courses	48*
5	Professional Elective courses relevant to chosen specialization/branch	18*
6	Open subjects - Electives from other technical and/or emerging subjects	18*
7	Project Work, Seminar and Internship in Industry or elsewhere	15*
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
	Total	160*

**Minor Variation is allowed as per need of the respective disciplines.*

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VISION

Imparting quality technical education and creation of skilled technocrats & innovative entrepreneurs to meet the global challenges in the society.

MISSION

To become a leading and unique department of higher learning by fostering the best teaching-learning environment supported by state-of-the-art infrastructure for practical realization of theoretical concepts and professional excellence. To impart outcome-based and continuously evolving curriculum by inculcating comprehensive domain knowledge to develop professional competence for meeting sustainable industrial and societal expectations. To inculcate human values and professional ethics amongst technocrats, researchers and entrepreneurs.

PROGRAMME EDUCATIONAL OBJECTIVES

1. Ability to generalize fundamental domain knowledge while working with electronic equipment/systems to handle engineering problems in professional career.
2. Ability to get profound knowledge of modern techniques, EDA tools and to acquire technical skills to innovate new/existing solutions to engineering problems.
3. Graduates will be known leaders in Electronics and Comm. Engineering and associated domains of engineering due their ability solve real-world inter-disciplinary problem.

PROGRAMME OUTCOMES (POs)

1. Working with Instruments: Appreciate working of electronic equipment/systems guided by practical experience and theoretical fundamental knowledge of Electronics & Communication Engineering.
2. Extrapolating Domain Knowledge: Ability to provide solutions to real-world problems in the field of Electronics & Communication Engineering by extrapolating the fundamental knowledge of electronic devices, circuits, embedded & communication systems.
3. Innovation and Design Ability: Innovative thinking and ability to design and/or improve products and/or systems for the society and industry for better utilization, human safety and reduced cost.

GRADUATE ATTRIBUTES (GAs)

1. Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. Problem Analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. Environment and Sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

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Semester III [Second year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1	UC-BTEC-301-19	Electronic Devices	3	0	0	3	40	60	100	3
2	UC-BTEC-302-19	Digital System Design	3	1	0	4	40	60	100	4
3	UC-BTEC-303-19	Electromagnetic Waves	3	1	0	4	40	60	100	4
4	UC-BTEC-304-19	Network Theory	3	1	0	4	40	60	100	4
5	BTAMXXX18	Mathematics III	3	1	0	4	40	60	100	4
6	UC-BTEC-311-19	Electronic Devices Laboratory	0	0	2	2	30	20	50	1
7	UC-BTEC-312-19	Digital System Design Laboratory	0	0	2	2	30	20	50	1
8	HSMC101-18 /HSMC102-18*	Foundational Course in Humanities (Development of Societies or Philosophy)	3	0	0	3	40	60	100	3
9	UC-BTEC-321-19	4-Week Institutional Training	0	0	4	4	40	60	100	Non-credit
10	BMPD-331-19	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**4**	**10**	**32**	**360**	**440**	**800**	**24**

Semester IV [Second year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	UC-BTEC-401-19	Analog Circuits	3	1	0	4	40	60	100	4
2	UC-BTEC-402-19	Microprocessors and Microcontrollers	3	1	0	4	40	60	100	4
3	BTCS-301-18	Data Structures & Algorithms	3	0	0	3	40	60	100	3
4	UC-BTEC-403-19	Signals and Systems	3	1	0	4	40	60	100	4
5	HSMC122-18	Universal Human Values – 2: Understanding Harmony	3	0	0	3	40	60	100	3
6	EVS-101-18	Mandatory Course-Environmental Sciences	3	0	0	3	100	0	100	Non-credit
7	UC-BTEC-411-19	Analog Circuits Laboratory	0	0	2	2	30	20	50	1
8	UC-BTEC-412-19	Microprocessors and Microcontrollers Laboratory	0	0	2	2	30	20	50	1
9	BMPD-341-19	Mentoring and Professional Development	0	0	2	Satisfactory/Un-satisfactory				Non-credit
		Total	**18**	**3**	**6**	**27**	**360**	**340**	**700**	**20**

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Semester V [Third year]

Branch/Course: Electronics and Communication Engineering

Sr. No.	Course code	Course Title	L	T	P	Hrs.	Internal Marks	External Marks	Total	Credit
1	UC-BTEC-501-19	Analog and Digital Communication	3	1	0	4	40	60	100	4
2	UC-BTEC-502-19	Digital Signal Processing	3	1	0	4	40	60	100	4
3	UC-BTEC-503-19	Linear Integrated Circuits	3	0	0	3	40	60	100	3
4	UC-BTEC-504-19	Control Systems	3	1	0	4	40	60	100	4
5	UC-BTEC-905X-18/19	Professional Elective-1	3	0	0	3	40	60	100	3
6	BTMS-YYY-18	Project Management	3	0	0	3	40	60	100	3
7	UC-BTEC-511-19	Analog and Digital Communication Laboratory	0	0	2	2	30	20	50	1
8	UC-BTEC-512-19	Digital Signal Processing Laboratory	0	0	2	2	30	20	50	1
9	UC-BTEC-513-19	Linear Integrated Circuits Laboratory	0	0	2	2	30	20	50	1
10	UC-BTEC-521-19	4-Weeks Industrial Training	0	0	6	6	60	40	100	Non-credit
11	UC-BTEC-10X-19	Professional Elective-1 Lab (Optional)	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
12	BMPD-351-19	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**3**	**16**	**37**	**390**	**460**	**850**	**24**

Semester VI [Third year]

Branch/Course: B.Tech. Electronics and Communication Engineering

Sr. No.	Course code	Course Title	L	T	P	Hrs	Internal Marks	External Marks	Total	Credits
1	UC-BTEC-601-19	Wireless Communication	3	0	0	3	40	60	100	3
2	UC-BTCS-602-19	Computer Networks	3	0	0	3	40	60	100	3
3	UC-BTEC-603-19	Optical Fibers & Communication	3	1	0	4	40	60	100	4
4	UC-BTEC-604-19	Microwave and Antenna Engineering	3	1	0	4	40	60	100	4
5	UC-BTEC-906X-18/19	Professional Elective-2	3	0	0	3	40	60	100	3
6	BTEC-XXX-19/23	Open Elective-1	3	0	0	3	40	60	100	3

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7	UC-BTEC-611-19	Optical Fibers & Communication Lab	0	0	2	2	30	20	50	1
8	UC-BTEC-612-19	Microwave and Antenna Engineering Laboratory	0	0	2	2	30	20	50	1
9	UC-BTEC-631-19	Project-I	0	0	3	3	60	40	100	3
10	UC-BTEC-11X-19	Professional Elective-2 Lab (Optional)	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
11	BMPD-361-19	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**2**	**11**	**31**	**360**	**440**	**800**	**25**

Semester VII/VIII [Fourth year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hr**	**Int Marks**	**Ext Marks**	**Total**	**Credits**
1	UC-BTEC-907X-18/19	Professional Elective-3	3	0	0	3	40	60	100	3
2	UC-BTEC-908X-18/19	Professional Elective-4	3	0	0	3	40	60	100	3
3	UC-BTEC-909X-18/19	Professional Elective-5	3	0	0	3	40	60	100	3
4	BTEC-YYY-19/23	Open Elective-2	3	0	0	3	40	60	100	3
5	BTEC-ZZZ-19	Open Elective-3	3	0	0	3	40	60	100	3
6	BTMC-101-18	Indian Constitution-Mandatory Course	3	0	0	3	40	60	100	Non-credit
7	BTMC-102-18	Essence of Indian Traditional Knowledge-Mandatory Course	3	0	0	3	40	60	100	Non-credit
8	UC-BTEC-731-19	Project-II & Report	0	0	12	12	120	80	200	6
9	UC-BTEC-12X-18/19	Professional Elective 3 or 4 or 5 Lab (Optional)**	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
10	BMPD-371-19	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**21**	**0**	**16**	**37**	**400**	**500**	**900**	**21**

Semester VII/VIII [Fourth year]						
B.Tech. Electronics and Communication Engineering						
Sr. No.	**Course code**	**Course Title**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1	UC-BTEC-801-19	Semester Software/Industrial Training & Project	300	200	500	16
		Total	**300**	**200**	**500**	**16**
Total Marks (including B.Tech. 1st Year)			**2680**	**3020**	**5700**	**168**

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OR

If the students (minimum 8 students) of any Institute/College do not opt for semester training, then the students shall be required to study the following:

Semester VII/VIII [Fourth year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Hr**	**Int Marks**	**Ext Marks**	**Total**	**Credits**
1	BTEC-aaaa-18/19	Professional Elective	3	0	0	3	40	60	100	3
2	BTEC-bbbb-18/19	Professional Elective	3	0	0	3	40	60	100	3
3	BTEC-cccc-18/19	Professional Elective	3	0	0	3	40	60	100	3
4	BTEC-dddd-18/19	Professional Elective	3	0	0	3	40	60	100	3
5	BTEC-802-19	Simulation and Modelling Lab (Minor Project & Report)	0	0	4	4	60	40	100	4
6	BMPD-381-19	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**12**	**0**	**6**	**18**	**220**	**280**	**500**	**16**

1. Four Professional Elective subjects (each of 3 credits) from any one of the Five Professional Elective Groups (excluding the group which the student has opted earlier).
2. The student will undertake and complete a Minor Project using Simulation and Modelling Lab & submit the Report.
3. Student has to complete 16 credits equivalent to that of One semester Industrial training in this course.

* Student may choose any one of these as foundational courses in HUSS group as given in AICTE Model Curriculum 2018.

Range of credits for Honors Degree -Minimum credits as per scheme are required by a student to be eligible to get Under Graduate degree in Electronics and Communication Engineering.

1. A student will be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. These could be acquired through MOOCs and registering in the department.
2.Range of Credits and Courses for Major Degree in B. Tech. (Electronics and Communication Engineering) and Minor Degree in B.Tech. (Other Engineering)
(i) A student admitted in B. Tech (ECE) may opt for Major Degree in B. Tech. (ECE) and Minor Degree in B.Tech. (other Engineering) with effect from 3rd semester onwards.
(ii) The student must clear his/her previous two semesters.
(iii) The student/candidate will require to clear at least five theory subjects for Minor Degree in B.Tech.

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Subjects for Minor Degree in B.Tech Electronics and Communication Engineering (ECE)

Core Subjects:

S.No.	Subject Code	Course Title	Credits
1.	UC-BTEC-305-18	Basic Electronics	3
2.	UC-BTEC-306-18	Digital Electronics	3
3.	UC-BTEC-401-18	Analog Circuits	4
4.	UC-BTEC-402-18	Microprocessors and Microcontrollers	4
5.	UC-BTEC-403-18	Signals and Systems	4
6.	UC-BTEC-502-18	Digital Signal processing	4
7.	UC-BTEC-501-18	Analog and Digital Communication	4
8.	UC-BTEC-503-18	Linear Integrated Circuits	3
9.	UC-BTEC-504-18	Control Systems	4
10.	UC-BTEC-601-18	Wireless Communication	3
11.	UC-BTEC-603-18	Optical Fibers and Communication	3
12.	UC-BTEC-604-18	Microwave and Antenna Engg.	4

Elective Subjects

S.No.	Subject Code	Course Title	Credits
1.	UC-BTEC- 301-18	Electronic Devices	3
2.	UC-BTEC- 303-18	Electromagnetic Waves	4
3.	UC-BTEC-906B-18	Satellite Communication	3
4.	BTEC-909A-18	Introduction to Big Data	3
5.	BTEC-908A-18	Artificial Intelligence	3
6.	BTEC-907A-18	Internet of Things (IoT) & Cloud Computing	3
7.	BTEC-907C-18	Robotics and Embedded systems	3
8.	BTEC-908C-18	VLSI Design	3
9.	BTEC-908D-18	Soft Computing	3
10.	BTEC-909D-18	Artificial Intelligence & Machine learning	3
11.	BTEC-907E-18	Adaptive Signal Processing	3
12.	BTEC-908E-18	Digital Image and Video Processing	3

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PROFESSIONAL (or PROGRAM) ELECTIVE (PE) COURSES [ELECTRONICS AND COMMUNICATION ENGINEERING]

The Professional Electives are categorized into three different Groups viz. Electronics Group, Communication Group and Software Group. The Program Elective Groups/courses have been categorized/developed keeping in mind the employment prospects of the students. The Program design in B.Tech. ECE aims at providing domain specific knowledge to a student at UG level in progression. The Program/course design has been carried out jointly by the Academia in close coordination with Industry to provide a leading edge to the students and to prepare them as per the Industry needs.

The student is free to choose any one group out of these listed groups. Therefore, the Head and the Faculty of the Department should provide complete guidance and take utmost care to apprise the students in a most diligent manner. Usually, it will not be a case to allow the change of the group, however, in the best interest of the students, a student can be allowed to change the group but the responsibility for teaching the pre requisite courses in the changed group shall rest with the Department/Institute.

Professional Elective Courses (2019 Onward)

Group Name	S. No.	Sem	Elective	Course Code	Course Title	L:T:P	Credits
Electronics Group	1	5	PE-1	UC-BTEC-901A-19	AC & DC Motors	3:0:0	3
	2	6	PE-2	UC-BTEC-902A-19	Power Electronics	3:0:0	3
	3	7	PE-3	BTEC-907A-18	Internet of Things (IoT) & Cloud Computing	3:0:0	3
	4	7	PE-3	BTEC-907C-18	Robotics & Embedded Systems	3:0:0	3
	5	7	PE-4	BTEC-908C-18	VLSI Design	3:0:0	3
	6	7	PE-5	BTEC-909C-18	Embedded Systems Design	3:0:0	3
	7	7	PE-5	BTEC-909E-18	Bio Medical Processing	3:0:0	3
Communication Group	1	5	PE-1	UC-BTEC-901C-19	Satellite Communication	3:0:0	3
	2	6	PE-2	UC-BTEC-902C-19	Mobile Adhoc Networks	3:0:0	3
	3	7	PE-3	BTEC-907B-18	Antenna Radiating Systems	3:0:0	3
	4	7	PE-4	BTEC-908A-18	Artificial Intelligence	3:0:0	3
	5	7	PE-4	BTEC-908F-19	Wireless Sensor Networks	3:0:0	3
	6	7	PE-5	BTEC-908D-18	Information Theory and Coding	3:0:0	3
	7	7	PE-5	BTEC-909D-18	Artificial Intelligence & Machine Learning	3:0:0	3
Software Group	1	5	PE-1	UC-BTEC-901E-19	Fuzzy Logic Systems	3:0:0	3
	2	5	PE-1	UC-BTEC-901F-19	JAVA Programing	3:0:0	3
	3	6	PE-2	UC-BTEC-902E-19	Artificial Neural Networks	3:0:0	3
	4	7	PE-3	BTEC-907D-18	Python Programming	3:0:0	3
	5	7	PE-3	BTEC-908D-18	Soft Computing	3:0:0	3
	6	7	PE-4	BTEC-907E-18	Adaptive Signal processing	3:0:0	3
	7	7	PE-4	BTEC-909A-18	Introduction to Big Data	3:0:0	3
	8	7	PE-5	BTEC-908E-18	Digital Image & Video Processing	3:0:0	3

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Note: Similar or any other non-repeating relevant courses available on SWAYAM, NPTEL or any other authentic MOOCs platform can be taken by the student with prior approval of Head of the Department. At the end of semester credits earned by the student will be considered for assessment equivalent to three credits in running semester.

LIST OF OPEN ELECTIVE (OE) COURSES OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING FOR STUDENTS OF OTHER PROGRAMS

For Odd Semester

Sr. No	Course Code	Course Title	L	T	P	Hours/ Week	Credits
1.	UC-BTEC-301-19	Electronic Devices	3	0	0	3	3
3.	BTEC-701-23	Entrepreneurship	3	0	0	3	3
4.	UC-BTEC-906B-18	Satellite Communication	3	0	0	3	3
5.	BTEC-907B-18	Antenna Radiating Systems	3	0	0	3	3
6.	BTEC-907C-18	Robotics and Embedded systems	3	0	0	3	3
7.	BTEC-908A-18	Artificial Intelligence	3	0	0	3	3
8.	BTEC-909A-18	Introduction to Big Data	3	0	0	3	3
9.	BTEC-909C-18	Embedded System Design	3	0	0	3	3
10.	BTEC-908D-18	Soft Computing	3	0	0	3	3

For Even Semester

Sr. No	Course Code	Course Title	L	T	P	Hours/ Week	Credits
1.	UC-BTEC-601-19	Wireless Communication	3	0	0	3	3
2.	BTCS-301-18	Data Structures & Algorithms	3	0	0	3	3
3.	BTEC-605-23	Human Resource Management	3	0	0	3	3
4.	UC-BTEC-902A-18	Power Electronics	3	0	0	3	3
5.	UC-BTEC-902C-18	Mobile Adhoc Networks	3	0	0	3	3
6.	UC-BTEC-902E-18	Artificial Neural Networks	3	0	0	3	3
7.	BTEC-909B-18	Information Theory and Coding	3	0	0	3	3
8.	BTEC-908C-18	VLSI Design	3	0	0	3	3

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MANDATORY COURSES (MC) (Non-Credit Courses)

Sr. No.	MC *	Course Code	Course Title	Hours/Week	Credits
1.	MC-1	BTMC-XXX-18	Environmental Sciences	3L:0T:0P	Nil
2.	MC-2	BTMC-YYY-18	Indian Constitution	3L:0T:0P	Nil
3.	MC-3	BTMC-ZZZ-18	Essence of Indian Traditional Knowledge	3L:0T:0P	Nil

IKGPTU HUSS Courses/Curricular Structure

Semester	L-T-P-C	Course No. & Title
1	2-1-0-3	L-101 Basic English
3	2-1-0-3	HSMC-103/HSMC-104 Foundation Course in Humanities (Development of Societies/Philosophy)
4	2-1-0-3	HSMC122-18 Universal Human Values – 2: Understanding Harmony
5-8	2-1-0-3	Humanities & Social Sciences Management Electives

List of Humanities & Social Sciences Including Management

Sr. No.	Course Code	Course Title	Hours	Credits
1.	HSMC101-18 /HSMC102-18	Foundational Course in Humanities (Development of Societies/Philosophy)	2L:10T:0P	3
2.	HSMC103-18	Education, Technology and Society	2L:10T:0P	3
3.	HSMC104-18	History of Science and Technology in India	2L:10T:0P	3
4.	HSMC105-18	Nyaya Logic Epistemology	2L:10T:0P	3
5.	HSMC106-18	Political and Economic Thought for a Humane Society	2L:10T:0P	3
6.	HSMC107-18	State, Nation Building and Politics in India	2L:10T:0P	3
7.	HSMC108-18	Psychological Process	2L:10T:0P	3
8.	HSMC109-18	Positive Psychology	2L:10T:0P	3
9.	HSMC110-18	Application of Psychology	2L:10T:0P	3
10.	HSMC111-18	Sociology, Society and Culture	2L:10T:0P	3
11.	HSMC112-18	Epochal Shift	2L:10T:0P	3
12.	HSMC113-18	Values and Ethics	2L:10T:0P	3
13.	HSMC114-18	Ethics and Holistic Life	2L:10T:0P	3
14.	HSMC115-18	Folk and Vernacular Expressive Tradition and Popular Culture	2L:10T:0P	3
15.	HSMC116-18	Universal Human Conduct	2L:10T:0P	3
16.	HSMC117-18	Gender Culture and Development	2L:10T:0P	3

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17.	HSMC118-18	Introduction to Women's and Gender Studies	2L:10T:0P	3
18.	HSMC118-18	Introduction to Women's and Gender Studies	2L:10T:0P	3
19.	HSMC119-18	Advance Course in Peace Research	2L:10T:0P	3
20.	HSMC120-18	Contemporary India in Globalized Era: Challenges of Democracy and Development	2L:10T:0P	3
21.	HSMC121-18	Making Indian Culture: Epistemic Traditions, Literature and Per formative Arts	2L:10T:0P	3
22.	HSMC122-18	Universal Human Values 2: Understanding Harmony	2L:10T:0P	3
23.	HSMC123-18	Human relations at work	2L:10T:0P	3
24.	HSMC124-18	Sanskrit Bhasa	2L:10T:0P	3
25.	HSMC125-18	Language and Communication	2L:10T:0P	3
26.	HSMC126-18	Language and Linguistics	2L:10T:0P	3
27.	HSMC127-18	Understanding Society and Culture through Literature	2L:10T:0P	3
28.	HSMC128-18	Fundamentals of Linguistics	2L:10T:0P	3
29.	HSMC128-18	Fundamentals of Linguistics	2L:10T:0P	3
30.	HSMC129-18	Elements of Literature	2L:10T:0P	3
31.	HSMC130-18	Humanities and Multiple Dimensions of Ecology	2L:10T:0P	3
32.	HSMC131-18	Film Appreciation	2L:10T:0P	3
33.	HSMC(MIM-472)	Introduction to Industrial Management	2L:10T:0P	3
34.	HSMC (MIM-480)	Macro Economics	2L:10T:0P	3
35.	HSMC (MIM-578)	Quantitative Methods for Decision Making	2L:10T:0P	3
36.	HSMC (MIM-475)	Economics for Engineers	2L:10T:0P	3
37.	HSMC (MME-301)	Fundamentals of Management for Engineers	2L:10T:0P	3
38.	HSMC (MME-302)	Project Management and Entrepreneurship	2L:10T:0P	3
39.	HSMC (MME-303)	Law and Engineering	2L:10T:0P	3
40.	HSMC (MME-304)	Understanding Interpersonal Dynamics	2L:10T:0P	3

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THIRD SEMESTER

B. Tech.

Electronics & Communication Engineering

Syllabus

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Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

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UC-BTEC-301-19	Credits	L	T	P	Int	Ext
Electronic Devices	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to recall concepts of semiconductor physics and understand the behaviour and working of semiconductor devices using mathematical models.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand physics of semiconductors and behavior of charge carriers within semiconductors
2. Understand the working of semiconductor diodes supported with mathematical explanation.
3. Understand the working of BJT and MOSFET with their equivalent circuit models.
4. Understand the chemical processes used in fabrication of integrated circuits.

Unit 1: Semiconductor Physics

Review of quantum mechanics; electrons in periodic lattices; e-k diagrams; energy bands in intrinsic and extrinsic silicon; diffusion current; drift current; mobility and resistivity.

Unit 2: Diodes

Generation and recombination of carriers; Poisson and continuity equation p-n junction characteristics; V-I characteristics; equivalent circuit models; avalanche breakdown; Zener diode; Schottky diode; light emitting diode; tunnel diode; varactor diode, solar cell, Rectifier circuits.

Unit 3: Transistors

Bipolar junction transistor; V-I characteristics; Ebers-Moll model; Transistor Configurations - CE, CB, CC; MOS capacitor; MOSFET - Construction and Working; I-V characteristics; Depletion-type and Enhancement-type MOS.

Unit 4: Fabrication Processes

Oxidation; diffusion; ion-implantation; Annealing; photolithography; etching; chemical vapour deposition (CVD); sputtering; twin-tub CMOS process.

Recommended Books

1. G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, Pearson.
2. D. Neamen, D. Biswas, Semiconductor Physics and Devices, McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, Physics of Semiconductor Devices, John Wiley & Sons
4. C. T. Sah, Fundamentals of solid state electronics, World Scientific Publishing Co. Inc.

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UC-BTEC-302-19	Credits	L	T	P	Int	Ext
Digital System Design	4	3	1	0	40	60

Course Objective

This is course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Apply concepts of Boolean algebra for handling logical expressions.
2. Understand working and realization of combinational circuits.
3. Understand working flip-flops and use them in designing of sequential circuits.
4. Understand fundamental concepts of logic families and architectural of programmable devices.

Unit 1- Number System and Binary Code

Introduction, Binary, Octal and Hexadecimal Number System, Conversion, Addition & Subtractions in number system. Signed and unsigned numbers, 1's and 2's compliment, ASCII code, Excess-3 code, Gray code, BCD code. Gates: AND, OR, NOT, NOR, NAND, EX-OR, EX-NOR, Basic theorem of Boolean Algebra, Sum of Products and Product of Sums, canonical form, Minimization of logic function, Minimization using K-map and Q-M method.

Unit 2- Combinational Circuits

Combinational circuit design, Adders, Subtractors and Code converters. Parity checker, seven segment display, Magnitude comparators. Encoders, decoders, Multiplexers, De-multiplexer, Implementation of combinational circuit using MUX.

Unit 3- Sequential Circuits

Flip flops, Clocked flip flops, SR, JK, D, T and edge triggered flip flops. Excitation tables of Flip flops. Shift Registers, Type of Shift Registers, Counter, Counter types, counter design with state equation and state diagrams. Logic families: RTL, ECL and CMOS.

Unit 4- D/A and A/D Converters & Semiconductor Memories

D/A convertors: Weighted register D/A converter, binary ladder D/A converter, A/D converter: Counter type A/D converter, Successive approximation A/D converter. Single and dual slope A/D converter, A/D accuracy and resolution. Memory organization, classification and characteristics of memories, Sequential memories, ROMs, R/W memories, PLA and PAL. Introduction to VHDL

Recommended Books

1. R.P. Jain, Modern digital Electronics, Tata McGraw Hill
2. A Anand Kumar, Fundamentals Of Digital Circuits, PHI, 2003
3. W.H. Gothmann, Digital Electronics-An introduction to theory and practice, PHI
4. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd
5. Bhaskar, A VHDL Primer, Prentice Hall

UC-BTEC-303-19	Credits	L	T	P	Int	Ext
Electromagnetic Waves	4	3	1	0	40	60

Course Objective

This course deals with knowledge and background required for better understanding of Electromagnetic Waves and fundamentals.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand characteristics & wave propagation through transmission lines
2. Understand Maxwell's equations for electromagnetic waves
3. Characterize uniform plane wave
4. Calculate reflection and transmission of waves at media interface

Unit 1: Transmission Lines

Equations of voltage and current on transmission line; propagation constant and characteristic impedance, Reflection coefficient and VSWR; Loss-less and Low-loss transmission line; S-parameters, Smith chart; Applications of transmission lines; Impedance matching; use of transmission line sections as circuit elements.

Unit 2: Maxwell's Equations

Basics of vectors; Co-ordinate system: Rectangular, Circular and Spherical Co-ordinate systems, Basic laws of Electromagnetics, Maxwell's equations and their interpretation, Boundary conditions at media Interface.

Unit 3: Uniform Plane Wave

Uniform plane wave; Propagation of wave; Wave polarization; Poincare's sphere; Wave propagation in conducting medium; phase and group velocity; Poynting vector; power loss in a conductor.

Unit 4: Plane Waves at a Media Interface

Plane wave in arbitrary direction; Reflection and Refraction at dielectric interface; Total Internal reflection; wave polarization at media interface; reflection from a conducting boundary.

Unit 5: Wave propagation in parallel plane waveguide

Analysis of Waveguide general approach; Rectangular waveguide, Surface currents on the waveguide walls, Attenuation in waveguide.

Recommended Books

1. RK Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India 2nd Edition, 2005.
2. EC Jordan & KG Balmain, Electromagnetic waves & Radiating Systems, PHI 2nd Edition, 1964.
3. NN Rao,Fundamentals of Engineering Electromagnetics, Prentice Hall 1972.
4. DK Cheng Field & Wave Electromagnetics, Prentice Hall 1989.

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UC-BTEC-304-19	Credits	L	T	P	Int	Ext
Network Theory	4	3	1	0	40	60

Course Objective

This course is meant to create mathematical foundation which can further be extrapolated to understand and analyze the electrical networks.

Course Outcomes

At the end of this course student will be able to:

1. Analyze linear networks using network theorems.
2. Use Laplace transform to analyze transient & steady state response of linear networks.
3. Comprehend network parameters to analyze two port networks.
4. Realize one port networks using Foster's and Cauer's methods.

Unit 1: Network Theorems

Node and mesh analysis; impedance matrix approach for networks analysis; Network theorems: superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC circuits; Trigonometric and Exponential Fourier series, Fourier Transform and continuous spectra Three phase unbalanced circuit and power calculation.

Unit 2: Transient & Steady State Analysis

Transient behavior, concept of complex frequency, Driving points, Poles and Zeros, Laplace transforms and properties: singularity functions, waveform synthesis; time domain analysis of RC, RL & RLC networks with and without initial conditions; Laplace Transforms for steady state and transient response of networks, quality factor.

Unit 3: Two Port Networks

Impedance parameters; admittance parameters; transmission parameters; hybrid parameters; inter-relationships between two port network parameters; interconnection of two port networks; T and Pi representation of two port networks; image impedance; characteristic impedance; propagation constant; filters: low pass, high pass; band pass, band stop & Butterworth filter.

Unit 4: Network Synthesis

Realizability criteria: Hurwitz polynomial, positive real functions; network realization using Foster's first and second forms; network synthesis using Cauer's first and second forms.

Recommended Books

1. Van, Valkenburg, Network Analysis, PHI
2. F F Kuo, Network Analysis & Synthesis, Wiley
3. A. Sudhakar, S P Shyammohan, Circuits and Network, Tata McGraw-Hill
4. A William Hayt, Engineering Circuit Analysis, McGraw-Hill Education

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BTAM-303-18	Credits	L	T	P	Int	Ext
Mathematics III	4	3	1	0	40	60

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables along with Probability and Correlation. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

The students will learn:

1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
5. To provide an overview of probability and statistics to engineers

Unit 1: Transforms Calculus-I

Laplace Transform, Properties of Laplace Transform, Laplace Transform of Unit step function, Impulse function, Dirac-delta function, Periodic functions. Inverse Laplace Transform, convolution theorem, Evaluation of integrals by Laplace Transform, Applications to ODEs and PDEs.

Unit 2: Transforms Calculus-II

Fourier Series, half range Fourier Sine and Cosine series, Fourier integrals, Gibbs Phenomenon, Fourier transforms, Relation between Laplace and Fourier transform, Properties of Fourier Transforms, Convolution Theorem and applications

Unit 3: Transforms Calculus-III

Basic theory of Z transforms, Translation theorem, Scaling property of Z transforms, Initial and Final value theorems, Differentiation of Z tranforms Solution of Difference equations using Z transform, Applications of Z transforms to find the sum of series

Unit 4: Probability

Conditional probability, Discrete and continuous random variables, Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distributions.

Unit 5: Correlation and regression

Correlation and Regression for bivariate data, Rank correlation, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance for small and large samples (z-test, t-test, F-test and Chi-square test).

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Recommended Books

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. R K jain and Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publishing, 2017.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
5. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.

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UC-BTEC-311-19	Credits	L	T	P	Int	Ext
Electronic Devices Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of semiconductor devices and making them to use in circuits & projects.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize use of diodes in circuits with proper understanding to their working.
2. Understand characteristics & working of BJT in different configurations.
3. Understand characteristics & working of MOSFET in circuits.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments

1. To Study datasheets of semiconductor devices.
2. To study the V-I characteristics of PN junction Zener diode.
3. To study a Zener diode as voltage regulator.
4. To study the output waveform of a Half-wave rectifier.
5. To study the output waveform of a Full-wave center-tapped and bridge rectifier.
6. To study Input & output V-I characteristics of npn/pnp BJT in CE configuration
7. To study Input & output V-I characteristics of npn/pnp BJT in CB configuration
8. To study Input & output V-I characteristics of npn/pnp BJT in CC configuration
9. To study the functioning of a BJT/MOSFET as a switch.
10. To study V-I Characteristics of a MOSFET.

Part-B: Lab Projects

Every individual student is required design and build one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Blinking linear/circular lights
2. Ambient light sensor based controller
3. Regulated dual power supply of ±5V or ±12V or mixed
4. BJT audio amplifier
5. BJT circuit for sampling of analog signal
6. Simulate any project idea using SPICE software

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UC-BTEC-312-19	Credits	L	T	P	Int	Ext
Digital System Design Lab	1	0	0	2	30	20

Course Objective

This is laboratory course meant to realize basic digital circuits using physical components and EDA tools in simulation environment.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize combinational circuits using logic gates.
2. Realize sequential circuits using logic gates.
3. Write & simulate VHDL programs for combinational & sequential circuits.
4. Think and design working projects using digital 74XX ICs.

Part-A: Experiments (Any 10 Experiments)

1. To verify the Truth-tables of all logic gates.
2. To realize and verify the Half & full adder circuits using logic gates.
3. To realize Half & full subtractor circuits using logic gates.
4. To realize 4-bit binary-gray & gray-binary converters.
5. To realize comparator circuit for two binary numbers of 2-bit each.
6. To realize Full adder & full subtractor circuits using 8x3 encoder.
7. To design Full adder & full subtractor circuits using 8x3 demultiplexer.
8. To design and verify the Truth tables of all flip-flops.
9. To design Mod-6/Mod-9 synchronous up-down counter.
10. To write VHDL program for combinational & sequential circuits from S. No. 2 to 7
11. To write VHDL program for universal shift-register operations

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Pulse Width Modulator based LED dimmer using 555 timer IC.
2. Up-down 4-bit counter with seven-segment display.
3. Construction of combinational circuits using universal gates.
4. Bi-directional visitors counter
5. Traffic light control system
6. Any project based on Arduino platform

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HSMC 101-18/HSMC 102-18	Credits	L	T	P	Int	Ext
Foundational Course in Humanities (Development of Societies or Philosophy)	3	3	0	0	40	60

The syllabus is same as in HUSS subjects given by AICTE Model Curriculum.

UC-BTEC-321-19	Credits	L	T	P	Int	Ext
4-Week Institutional Training	Non-credit	0	0	4	60	40

Four weeks training in the area of Electronics and Communication Engineering. This training should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her.

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BMPD-331-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record of students for each activity conducted and the same shall be submitted to the department.

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FOURTH SEMESTER

B. Tech.

Electronics & Communication Engineering

Syllabus

I K Gujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

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UC-BTEC-401-19	Credits	L	T	P	Int	Ext
Analog Circuits	4	3	1	0	40	60

Course Objective

This course deals design & analytical concepts of various Analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will be able to:

1. Understand the biasing of transistors and analyze BJT/FET amplifiers
2. Analyze various rectifier and amplifier circuits
3. Analyze sinusoidal and non-sinusoidal oscillators
4. Understand various types of Power Amplifiers

Unit 1: Diode and Transistor Amplifier Circuits

Diode Circuits, Amplifiers types: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier; biasing schemes for BJT and FET amplifiers; bias stability; transistor configurations: CE/CS, CB/CG, CC/CD and their features; small-signal analysis; low-frequency transistor models; amplifier analysis: current gain, voltage gain, input resistance and output resistance; amplifier design procedure; low frequency analysis of multistage amplifiers. High frequency transistor models.

Unit 2: Feedback Amplifiers

Feedback topologies: Voltage series, current series, voltage shunt and current shunt feedback; effect of feedback on gain, bandwidth, input & output impedances; concept of stability, gain margin and phase margin.

Unit 3: Oscillators Introduction, Types of Oscillators, Barkhausen criterion, RC-phase shift, Wien bridge, Hartley, Colpitt, Clapp oscillators and non-sinusoidal oscillators.

Unit 4: Power Amplifiers

Class A, B, AB and C power amplifiers, their efficiency and distortions; frequency response: single stage, multistage amplifiers and cascade amplifier.

Recommended Books

1. J Millman & A Grabel, Microelectronics, McGraw Hill
2. J Millman & C Halkias, Integrated Electronics, Tata McGraw Hill
3. A Ramakant, Gayakwad, Op-Amps And Linear Integrated Circuits, PHI
4. P Horowitz & W Hill, The Art of Electronics, Cambridge University Press
5. A S Sedra & K C Smith, Microelectronic Circuits, Saunder's College Publishing

UC-BTEC-402-19	Credits	L	T	P	Int	Ext
Microprocessors and Microcontrollers	4	3	1	0	40	60

Course Objective

This is course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand architecture &functionalities of different building block of 8085 microprocessor.
2. Understand working of different building blocks of 8051 microcontroller.
3. Comprehend and apply programming aspects of 8051 microcontroller.
4. Interface & interact with different peripherals and devices.

Unit 1: Microprocessor 8085

History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; programming techniques, counters and time delays; stack and subroutines; interrupts.

Unit 2: Microcontroller 8051 - Building Blocks

Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

Unit 3: Microcontroller 8051 - Programming

Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

Unit 4: Microcontroller 8051 - Interfacing

Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

Recommended Books

1. R S Gaonkar, Microprocessor Architecture, Programming and Application with 8085, Penram International Publishing Pvt. Ltd.

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2. Kenneth Ayala, The 8051 Microcontroller, Cengage Learning
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill
4. Subrata Ghoshal, 8051 Microcontroller: Internals, Instructions, Programming and Interfacing, Pearson Education
5. K Uma Rao, Andhe Pallavi, The 8051 Microcontrollers: Architecture, Programming and Applications, Pearson Education.

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BTCS-301-18	Credits	L	T	P	Int	Ext
Data Structures and Algorithms	3	3	0	0	40	60

Finalized by the concerned Board of Studies of Department of Computer Science and Engineering.

Course Objectives:

The objective of the course is to impart the basic concepts of data structures and algorithms, to understand concepts about searching and sorting technique and to understand basic concepts about stacks, queues, lists, trees and graphs, data structures.

Course outcomes

Student will be able to:

1. Understand operations like searching, insertion, deletion, traversing on linear Data Structures and to determine their computational complexities
2. Understand operations like searching, insertion, deletion, traversing on various nonlinear Data Structures and to determine their computational complexities
3. Write algorithms for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
4. Apply appropriate Data Structure as per specific problem definition

Detailed contents: Module 1:

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Introduction to pointers and dynamic memory allocation, use of pointers in self-referential data structures.

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. 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

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and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis, Applications of Binary Trees.

Module 4:

Sorting and Hashing: 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.

Suggested books:

1. "Classic Data Stuructures", Samanta and Debasis, PHI publishers
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
3. "Data Structures with C (Schaum's Outline Series)",Seymour Lipschutz, Mc Graw Hill.
4. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
5. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

HSMC 122-18	Credits	L	T	P	Int	Ext
Universal Human Values-2 : Understanding Harmony	3	3	0	0	40	60

The syllabus of this course is same as given in detailed HUSS group syllabus in AICTE Model Curriculum 2018.

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UC-BTEC-403-19	Credits	L	T	P	Int	Ext
Signals & Systems	4	3	1	0	40	60

Course Objective: The objective of this course is to enable students to apply mathematical concepts and tool in analysis of electrical signals and systems.

Course outcomes:

At the end of this course students will demonstrate the ability to:

1. Mathematically characterize different types of signals and systems.
2. Analyze the behavior of linear-shift invariant systems.
3. Apply concepts of Fourier and Laplace Transforms to analyze continuous-time signals and systems.
4. Investigate discrete-time signals and systems using Discrete-Time Fourier and Z-Transforms and simple Probability concepts.

Unit 1: Introduction to Signals and Systems

Classification of Signals: Periodic and Aperiodic signals, continuous and discrete time signals, continuous and discrete amplitude signals; Linear and nonlinear signals, Causal and non-causal signals, Even and odd signals, Energy and power signals; System properties: linearity, shift-invariance, causality, stability, Realizability.

Unit 2: Linear-Shift Invariant Systems

Linear shift-invariant systems. Impulse response and step response ;Convolution, Input-output behaviour with Aperiodic convergent inputs; Characterization of causality and stability of LSI systems; System representation through differential equations and difference equations; Periodic inputs to an LSI system; Notion of frequency response and its relation to the impulse response.

Unit 3: Continuous-Time Analysis of Signals and Systems

Fourier Series; Fourier Transform; Magnitude and phase response; Properties of Fourier Transform: Convolution/Multiplication, Duality, Time-shifting, Frequency-shifting, Time-scaling, Integration and differentiation in time-domain; Review of Laplace Transform for continuous-time signals and systems; Notion of Eigen functions of LSI systems; System transfer function and poles-zeros analysis; Solution to differential equations and system behaviour.

Unit 4: Discrete-Time Analysis of Signals and Systems

Sampling Theorem and its proof; Spectra of sampled signals; Aliasing and its effects; Reconstruction and its implications; Probability: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions. Discrete-Time Fourier Transform (DTFT); Discrete Fourier Transform; Parseval's Theorem; Review of Z-Transform for discrete-time signals and systems; System functions; Region of convergence and z-domain analysis, Conditional Probability.

Recommended Books:

1. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education
2. I J Nagrath, S N Sharan, R Ranjan S Kumar, Signals and Systems, Tata McGraw Hill
3. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press
4. S Poornachandra, B Sasikala, Signals and Systems, Tata McGraw Hill
5. Robert A. Gabel, Richard A. Roberts, Signals and Linear Systems, John Wiley and Sons.

EVS-101-18	Credits	L	T	P	Int	Total
Mandatory Course: Environmental Sciences	Non-credit	3	0	0	100	100

Finalized by the Board of Studies of Department of Civil Engineering.

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

1. Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1: Natural Resources: Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

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e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

Module 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem
b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India

Module 4: Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rehabilitation of people; its problems and concerns.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust. Case Studies.
- Public awareness.

*ACTIVITIES

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity)

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

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Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems

1*(A) Awareness Activities:*

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) Drive for segregation of waste
i) To live with some eminent environmentalist for a week or so to understand his work
j) To work in kitchen garden for mess
k) To know about the different varieties of plants
l) Shutting down the fans and ACs of the campus for an hour or so
m) Visit to a local area to document environmental assets river/forest/grassland/hill/mountain/lake/Estuary/Wetlands
n) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
o) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach. The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H &Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

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UC-BTEC-411-19	Credits	L	T	P	Int	Ext
Analog Circuits Lab	1	0	0	2	30	20

Course Objective

This laboratory course deals design & analytical concepts of various analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Study and verify the characteristics of diodes/BJTs in circuits with proper understanding to their working.
2. Understand frequency response & working of various types of Oscillators.
3. Understand characteristics & working of Power amplifiers.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments:

1. To Study the Output waveforms of diode clipper and Diode Clamper circuits.
2. To study the Input/Output V-I characteristics of BJT in CE configuration.
3. To study Emitter follower circuit.
4. To calculate the frequency of RC phase shift oscillator.
5. To measure the frequency of Wein bridge oscillator.
6. To measure the frequency of Hartley oscillator.
7. To measure the frequency of Colpitt's oscillator.
8. To study Gain analysis of Class-A Power Amplifier
9. To study Gain analysis of Class-B Power Amplifier
10. To study Gain analysis of Class B Push-pull Power Amplifier

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. BJT audio amplifier
2. Op-Amp based square and triangular waveform generator
3. Any project based on IoT/Arduino platform

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UC-BTEC-412-19	Credits	L	T	P	Int	Ext
Microprocessors and Microcontrollers Lab	1	0	0	2	30	20

Course Objective

This is laboratory course meant to write programs using 8085/8086 microprocessor and learn interfacing using 8051 microcontoller for general operations.

Course Outcomes

At the end of this Lab course student will be able to:

1. Write programs for common arithmetic operations with 8-bit/16-bit numbers using 8085.
2. Write programs for transfer, sort block of data with 8085 processor.
3. Write programs for controlling stepper and DC motors using Microprocessor(s).
4. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller.

Part-A: Write programs in Assembly language & embedded C to

1. Add two 8-bit numbers stored in registers or internal/External memory locations.
2. Multiply two 8-bit numbers.
3. Multiply two 16-bit numbers.
4. Transfer block of data from internal memory locations to external memory locations
5. Sort block of data in ascending or descending order.
6. Generate 5KHz pulse waveform of 50% duty cycle.
7. Interface ADC and DAC.
8. Interface Matrix Keyboard.
9. Interface LCD Displays.
10. Interface Stepper Motor.
11. Control DC motor using PWM.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. RFID attendance system
2. Home automation
3. Robotic vehicle
4. Sensor traffic lights
5. Floor cleaning robot
6. Robot for defense applications
7. GPS vehicle tracking
8. Accident identification and SMS

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BMPD-341-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development
The objective of mentoring will be development of:
- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

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FIFTH SEMESTER

B. Tech.

Electronics & Communication Engineering

Syllabus

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UC-BTEC-501-19	Credits	L	T	P	Int	Ext
Analog and Digital Communication	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Analog as well as Digital Communication and understand the working of common communication techniques.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB, Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals

Unit 2: Elements of Detection Theory

Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De-emphasis. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 3: Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering", John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

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UC-BTEC-502-19	Credits	L	T	P	Int	Ext
Digital Signal Processing	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Digital Signal Processing and understand the commonly used digital filters and systems.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

Unit 1: Discrete Time Signals & Systems

Review of Signals & System, Discrete time sequences and systems; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. Implementation of Discrete Time Systems, Linear Periodic and Circular convolution, Z-Transform, Inverse Z-Transform methods, Properties of Z-Transform.

Unit 2: Analysis of Discrete LTI sytesms

Analysis of Linear time invariant systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) with their properties, Inverse DFT and FFT methods, Goertzel Algorithm.

Unit 3: Digital filters Design

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Time Invariant and Bilinear Transformation Methods, Rectangular, Hamming and Hanning Window methods, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters. Effect of finite register length in FIR filter design, Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain.

Unit 4: Introduction to Multirate signal processing and DSP processors

Concepts of Multirate Signal Processing, need and significance, Applications of DSP, Limitations of Analog signal processing, Advantages of Digital signal processing, Introduction to Architectures of ADSP and TMS (C6XXX) series of processors.

Recommended Books

1. S. K. Mitra, Digital Signal Processing: A computer based approach. TMH, 2001.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

UC-BTEC-503-19	Credits	L	T	P	Int	Ext
Linear Integrated Circuits	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to introduce the theoretical & circuit aspects of Op-amp, which is the backbone for the basics of Linear integrated circuits.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. **Infer** AC & DC analysis of constituent blocks of Op-Amp.
2. **Interpret** and **elaborate** the characteristics and parameters of Op-Amp circuits.
3. **Analyze** and **design** linear and non-linear applications using op-Amp circuits.
4. **Explain** working and applications of Timer, PLL and Voltage regulators ICs.

Unit I: Differential Amplifiers

Differential amplifier circuit configurations: Dual input-balanced output, Dual input-unbalanced output, Single input-balanced output and Single input-unbalanced output differential amplifier; DC analysis of differential amplifier; AC analysis of differential amplifier differential; Differential amplifier with swamping resistors; Constant current bias and current mirror circuits; Level translator circuit; Differential amplifier using Op-Amp;

Unit II: Operational Amplifiers

Op-Amp IC741: Block diagram representation, Schematic representation, IC packaging types, Pin Identification, Operational temperature ranges, Overview & interpretation of IC datasheets; Characteristics of ideal and practical Op-Amp; Equivalent circuit of an Op-Amp and its voltage transfer curve; Op-Amp parameters: Input offset voltage, Input bias current, Input offset current, Output offset voltage, Thermal drift, Common Mode Rejection Ratio (CMRR), Power Supply Rejection Ratio (PSRR), Slew rate; Effects of positive and negative feedbacks on Op-Amp circuits.

Unit III: Applications of Op-Amp

DC and AC amplifiers: Differential, Inverting & Non-Inverting amplifiers; Peaking Amplifier; Summing, Scaling, Averaging Amplifiers & D/A Converter; Voltage to current converter; Current to voltage converter; Log and Antilog amplifier; Integrator circuit; Differentiator circuit; Comparator circuit; Window detector; Zero-crossing detector; Schmitt trigger; Butterworth filters: First order low pass and high pass filters, Second order low pass and high pass filters, Higher order filters, Band pass filter, Band reject filters and all pass filter; Oscillators & waveform generators: Phase shift oscillator, Wein bridge oscillator, Quadrature oscillator, Square wave generator, Triangular wave generator, Sawtooth wave generator, Voltage controlled oscillator; V to F and F to V converters; Instrumentation Amplifier.

Unit IV: Specialized IC Applications

IC 555 Timer: Pin configuration, Block diagram; Application of IC 555: Monostable, Astable and Bistable multivibrator; Phase Lock Loops: Operating principles & applications of IC 565; Voltage Regulators: Fixed voltage regulators, Adjustable voltage regulators, Switching regulators.

Recommended Books

1. Op Amps & Linear Integrated Circuits by Ramakant A. Gayakwad, Pearson, 4th Ed.
2. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH

3. Operational Amplifiers and Linear Integrated Circuits by R.F. Coughlin & F.F. Driscoll, PHI, 1996

UC-BTEC-504-19	Credits	L	T	P	Int	Ext
Control Systems	4	3	1	0	40	60

Course Objective
This is the course meant to gain the knowledge of important control systems, characterize them and study their state behaviour.

Course Outcomes
At the end of this course students will demonstrate the ability to
1. Characterize a system and find its study state behaviour
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve liner, non-liner and optimal control problems

Unit 1: Introduction to Control Systems
Industrial Control system examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, DC and AC servomotors, Tacho generators, Electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Open loop and Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback Control systems
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion. Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design.

Unit 3: Frequency Response Analysis
Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. State variable formulation and solution.

Unit 4: State variable Analysis
Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Recommended Books:
1. Manke,B.S "Linear Control Systems" Khanna Publishers, Twelfth Edition,2005
2. Gopal. M., "Control Systems: Principles and Design", Tata Mc Graw-Hill, 1997.
3. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
4. Ogata, K., "Modern Control Engineering" , Prentice Hall, second edition, 1991.
5. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi.

BTMS-YYY18	Credits	L	T	P	Int	Ext
Project Management	3	3	0	0	40	60

Course Objective: To acquaint the students with the steps involved in the planning, implementation, scheduling and control of projects.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Study the basic concepts of Project Management.
2. Learn about Project selection and organisation.
3. Understand Project planning and scheduling.
4. Learn about Project Monitoring, control and performance.

UNIT-I: Project Management Concepts Attributes of a Project, Project Life Cycle, The Project management Process, Global Project Management, Benefits of Project Management, Needs Identification.

UNIT-II: Project Selection, Preparing a Request for Proposal, Soliciting Proposals, Project organization, the project as part of the functional organization, pure project organization, the matrix organization, mixed organizational systems.

UNIT-III: Project Planning and Scheduling: Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource allocation, Crashing and Resource Sharing.

UNIT-IV: Project Monitoring/Control and Project Performance: Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Recommended Books:

1. Chandra, P. (2017). Projects: Preparation, Appraisal, Budgeting and Implementation. 8th Edition, Tata Mcgraw.
2. Desai, V. (2017). Project Management and Entreprenueurship. 2nd Edition, Himalaya Publishing House.
3. Fyffe, D. S. (2001). Project Feasibility Analysis. New York: John Wiley and Sons.
4. Ragaranjan K. (2005). Elements of project Management. 1st Edition, New Age International.

UC-BTEC-901A-19	Credits	L	T	P	Int	Ext
AC & DC MOTORS	3	3	0	0	40	60

Course Objectives: The Objective of this course is to introduce the ECE undergraduates to basic concepts, constructional features and working of DC, AC and Special motors.

Course Outcomes: After undergoing this course students will be able to

I. Understand the principle of energy conversion.
II. Explain the working principle, construction and applications of DC motors.
III. Explain the working principle, construction and applications of AC motors.
IV. Gain knowledge about the fundamentals of Special motors.

UNIT I: Introduction Energy conversion principle

Concept of co-energy, Coupling field reaction for energy conversion, Mechanical work, Mechanical forces and torques in singly and doubly excited systems. Concepts of reluctance and electromagnetic torques. Singly excited electric field systems.

UNIT II: DC Motors

Constructional features and principle of working, Function of the Commutator for motoring and generating action, Types of armature winding, factors determining induced e.m.f., Factors determining electromagnetic torque, Relationship between terminal Voltage and induced e.m.f. for different DC machines, Factors determining Speed of DC motors, Speed control methods, Performance Characteristics of different DC Machines(working as motors and generators), Starting of DC motors and starters, Application of DC motors.

UNIT III: AC Motors

Brief introduction about three phase induction motors, Principle of operation, Types of induction Motors and constructional feature of squirrel cage and slip ring motors, Starting of three phase induction motors: Star Delta and DOL (direct-on-line) starters, Reversal of direction of rotation of three motors, Application of Induction Motors, Introduction of Synchronous Machines, alternators and its principle of operation, Synchronous motors and their applications.

UNIT IV: Special Motors

Single phase synchronous motors, Reluctance motors, Hysteresis motors, Linear induction motor, stepper motors, step angle, variable reluctance stepper motor, Permanent magnet stepper motor, Detent torque, Hybrid stepper motor, Torque-pulse rate characteristics, Applications of stepping motors, Permanent magnet DC motors, printed circuit board motors.

Recommended Text and Reference Books

1. P. S. Bimbhra, Electrical Machinery, Khanna Publications.
2. P.S. Bimbhra, Generalized Theory of Electrical machines, Khanna Publications.
3. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill.
4. Ashfaq Hussain, Electric Machines, Dhanpat Rai & Co.

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UC-BTEC-901C-19	Credits	L	T	P	Int	Ext
SATELLITE COMMUNICATION	3	3	0	0	40	60

Course Objectives

This course presents the fundamentals of satellite communications link design and an in-depth knowledge of practical considerations. After going through this course they will have better understanding of unique challenges of designing, developing and operating satellite communications systems.

Course Outcomes

After undergoing this course students will be able to

I. Interpret & define basics of Satellite communication, understand the complete link design along with and the interference effects on it.
II. Understand various fixed and demand assignment multiple access techniques.
III. Understand the special purpose communication satellites.
IV. Have knowledge of laser satellite communication and CATV system.

Unit I: Introduction to Satellite Communication

Evolution and growth of communication satellite, Advantages of satellite communication, Active & Passive satellite, Orbital aspects and their effects on satellite communications.

Unit II: Satellite Link Design

Basic transmission theory, Link design equation, System noise temperature, C/N & G/T ratio, Atmospheric & ionospheric effects on link design, Uplink design, Complete link design, Interference effects on complete link design, Earth station parameters, Earth space propagation effects, Frequency window, Free space loss, Atmospheric absorption, Rainfall Attenuation, Ionospheric scintillation, Telemetry, Tracking and command of satellites.

Unit III: Fixed and Demand Assignment Multiple Access Systems

FDMA techniques, SCPC & CSSB systems, TDMA frame structure, Burst structure, Frame efficiency, Super-frame, Frame acquisition & synchronization, TDMA vs FDMA, Burst time plan, Beam hopping, Satellite switched, Erlang call congestion formula, DA-FDMA, DA-TDMA.

Unit IV: Special Purpose Communication Satellites

INTELSAT, INSAT Series, VSAT, Weather forecasting, Remote sensing, LANDSAT, Satellite Navigation, Mobile satellite Service, Defence satellites.

Unit V: Laser Satellite Communication and CATV System

Link analysis, Optical satellite link Tx & Rx, Satellite beam acquisition, Tracking & pointing, Cable channel frequency, Head end equation, Distribution of signal, Network specifications and architecture, Optical fibre CATV system.

Recommended Text and Reference Books

1. Trimothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons.
2. Dr. D.C. Aggarwal, Satellite Communications, Khanna Publishers.
3. Dennis Roddy, Satellite Communications, McGraw Hill. 4. K.N. Raja Rao, Fundamentals of Satellite Communications, Prentice Hall India Learning Private Limited.

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UC-BTEC-901E-19	Credits	L	T	P	Int	Ext
FUZZY LOGIC SYSTEMS	3	3	0	0	40	60

Course Objectives

The Objective is to develop the skills to gain a basic understanding on fuzzy logic theory and neural networks and use these for controlling real time systems.

Course Outcomes

After undergoing this course, students will be able to

I. Understand the learning and working of basic artificial neural models and their network topologies.
II. Get exposure of feed forward neural networks.
III. Gain knowledge about basic learning laws of various neural models.
IV. Learn the basic concepts and working of fuzzy Logic sets and components to develop and implement a basic trainable neural network or a fuzzy logic system for any application.

Unit-I: Introduction to Neural Networks

Introduction, Humans and computers, Organization of the brain, Biological neuron, Difference between biological and artificial neuron models, Characteristics of ANN, Historical developments, Potential applications of ANN, Different artificial neuron models, Operations of artificial neuron, Types of neuron activation function, ANN architectures, Classification taxonomy of ANN, Connectivity, Neural dynamics (Activation and synaptic), Network topologies, Learning strategy (Supervised, unsupervised, reinforcement), Learning rules.

Unit–II: Single Layer and Multilayer Feed- Forward Neural Networks

Perception models: Discrete, continuous and multi-Category, Training algorithms: Discrete and continuous perception networks. Perception convergence theorem, Limitations of the perception model, Applications. Credit assignment problem, Generalized delta rule, Derivation of back propagation (BP) training, Summary of back propagation algorithm, Kolmogorov theorem, Learning difficulties and improvements.

Unit-III: Fuzzy Sets and Components

Classical sets, Operations and relations, Fuzzy sets and its properties, Fuzzy relations, Membership functions, Fuzzification, Development of rule base and decision making system, De-fuzzification and its techniques, Fuzzy logic system: Block diagram, Implementation, Fuzzy logic controller Vs PID controller.

Unit –IV: Application of Fuzzy Logic Control

Inverted pendulum, Image processing, Home-heating system, Blood pressure during anesthesia, Introduction to neuro-fuzzy controller, Antilock Braking System (ABS).

Recommended Text and Reference Books

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley publications.
2. Yegnanarayanan, Artificial Neural Networks, Prentice Hall of India Pvt. Ltd.
3. Bart Kosko, Neural Networks & Fuzzy Logic, Prentice Hall.
4. Simon S. Haykin, Neural Networks, Prentice Hall.

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UC-BTEC-901F-19	Credits	L	T	P	Int	Ext
JAVA Programming	3	3	0	0	40	60

Course Outcomes

After this course the students will be able to:

1. Apply the concepts and basics of JAVA
2. Demonstrate the knowledge of operators and control statements
3. Ability to learn about Inheritance, Interface, Applets.
4. Learn about JAVA database connectivity

Introduction to Java: History of Java, Features of Java, Java Development Kit (JDK), Security in Java, Java Basics: Keywords; Working of Java; Including Comments; Data Types in Java; Primitive Data Types; Abstract / Derived Data Types; Variables in Java; Using Classes in Java; Declaring Methods in Java, Code to Display Test Value; The main () Method, Invoking a Method in Java; Saving, Compiling and Executing Java Programs

Operators and Control Statements: Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators, Logical Operators, Operator Precedence; Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do…While Loop, Break Statement Continue Statement Arrays and Strings: Arrays; String Handling; Special String Operations; Character Extraction; String Comparison; Searching Strings; String Modification; String Buffer

Inheritance, Package and Interface: Inheritance, Types of Relationships, What is Inheritance?, Significance of Generalization, Inheritance in Java, Access Specifiers, The Abstract Class; Packages, Defining a Package, CLASSPATH; Interface, Defining an Interface, Some Uses of Interfaces, Interfaces versus Abstract Classes Exception Handling: Definition of an Exception; Exception Classes; Common Exceptions; Exception Handling Techniques, Streams in Java: Streams Basics; The Abstract Streams; Stream Classes; Readers and Writers; Random Access Files; Serialization

Applets: What are Applets?; The Applet Class; The Applet and HTML; Life Cycle of an Applet; The Graphics Class; Painting the Applet; User Interfaces for Applet; Adding Components to user interface: AWT (Abstract Windowing Toolkit) Control, Event Handling: Components of an Event; Event Classes; Event Listener; Event-Handling; Adapter Classes; Inner Classes; Anonymous Classes, Swing: Concepts of Swing; Java Foundation Class (JFC)

Java Data Base Connectivity: Java Data Base Connectivity; Database Management; Mechanism for connecting to a back end database; Loading the ODBC driver, RMI, CORBA and Java Beans: Remote Method Invocation (RMI); RMI Terminology; Common Object Request Broker Architecture (CORBA), Java IDL

Recommended Books:

1. Programming with Java A Primer, 5th Edition, E. Balagurusamy, Tata Mcgraw Hill.
2. Java Programming for Core and Advanced Learners, Sagayaraja, Denis, Karthik, Gajalakshmi, Universities Press.
3. Java Fundamentals, A Comprehensive Introduction, H. Schildt, D. Skrien, Tata McGraw Hill.
4. Java, The complete Reference, H. Schildt, 7th Edition, Tata McGraw Hill.

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UC-BTEC-511-19	Credits	L	T	P	Int	Ext
Analog and Digital Communication Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study and investigate the outputs of various Analog and digital modulation techniques.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Study and verify the characteristics and output waveforms of AM, FM, PCM
2. Study and compare noise in AM and FM systems
3. Investigate the output responses of PAM, PCM, PSK, FSK, MSK.

List of Experiments:

1. To study the Characteristics/output waveform of Amplitude Modulation and demodulation techniques.
2. To Investigate and compare the outputs of SSB, DSB-SC and VSB Modulation systems.
3. To study and compare Noise Interference in AM and FM systems.
4. To study the effect of threshold in Angle modulation.
5. To study the effect of Sampling and Investigate the Output response of Pulse Amplitude Modulation.
6. To Investigate the Output response of Pulse Code Modulation.
7. To Study the output response of PSK & FSK.
8. To Study Delta modulation and demodulation technique and observe effect of slope overload.
9. To study the output response of QAM.
10. To study the output response of Continuous Phase Modulation.
11. To study the output response of Minimum Shift keying.
12. Digital link simulation; error introduction & error estimation in a digital link using MATLAB (SIMULINK)/ communication simulation packages.

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UC-BTEC-512-19	Credits	L	T	P	Int	Ext
Digital Signal Processing Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of Digital Signal Processing and its applications.

Course Outcomes

At the end of this course student will demonstrate the ability to:
1. Write programs to develop various signals.
2. Write programs to generate standard sequences.
3. Develop programs to verify convolution
4. Develop programs to design various filters.

List of Experiments: Perform the following exercises using MATLAB

1. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences.
2. Write a program in MATLAB to generate standard sequences.
3. Write a program in MATLAB to compute power density spectrum of a sequence.
4. To develop program modules based on operation on sequences like signal Shifting, signal folding, signal addition and signal multiplication.
5. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
6. To write a MATLAB programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a discrete-time causal system.

List of Lab Experiments on hardware: (using C6xxx board, Code composer studio and Acarya app)

7. Implementation Linear and Circular Convolution
8. To Find DFT and IDFT of given time DT Signal
9. N point FFT Algorithm implementation
10. Digital Filter Design - FIR Filter Implementation
11. Digital Filter Design - IIR Filter Implementation
12. Configuring Audio Codec of C6xxx Boards
13. Configuration of Audio Input and Output Channels (Loopback/Talkback using Acarya Application)
14. Implementation of Audio Delay Line, Echo and Audio Reverberation
15. Applications - Digital Signal Generations
16. Moving Average filter Design (Noise Cancellation using Acarya Application Reference)

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UC-BTEC-513-19	Credits	L	T	P	Int	Ext
Linear Integrated Circuits Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of the concepts of Linear Integrated Circuits.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Study and investigate the configurations of Differential amplifiers.
2. Measure the performance parameters of am OP-Amp.
3. Use Op-Amps for various applications.

List of Experiments (Minimum 12 experiments to be performed):

1. Study differential amplifier configurations.
2. Measure the performance parameters of an Op amp.
3. Application of Op amp as Inverting and Non Inverting amplifier.
4. Study frequency response of an Op Amp and determine Gain-Bandwidth product
5. Application of Op-Amp as summing, scaling & averaging amplifier.
6. Application of Op-Amp as Instrumentation amplifier
7. Design differentiator and Integrator using Op-Amp.
8. Design Low pass, High pass and Band pass 1st order Butterworth active filters using Op-amp
9. Design Phase shift and Wein Bridge oscillator using Op-Amp.
10. Application of Op Amp as square wave, triangular wave and Sawtooth wave generator.
11. Application of Op Amp as Zero Crossing detector and window detector.
12. Application of Op Amp as Schmitt Trigger.
13. Application of 555 as Monostable and Astable multivibrator.
14. Examine the operation of a PLL and determine the free running frequency, the capture range and the lock in range of PLL.

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UC-BTEC-521-19	Credits	L	T	P	Int	Ext
4-Week Industrial Training I	Non-credit	0	0	6	60	40

Minimum of four weeks in an Industry in the area of Electronics and Communication Engineering at the end of 4th Semester. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to the student. The outcome of the internship should be presented in the presence of the Peers and Faculty with a Power point Presentation and submit the hard copy report duly endorsed by the Industry for Evaluation to the Department. A Viva-voce will be conducted.

BMPD-351-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory
* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty in-charges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

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SIXTH SEMESTER

B.Tech.

Electronics & Communication Engineering (ECE)

Syllabus

I K Gujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

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UC-BTEC-601-19	Credits	L	T	P	Int	Ext
Wireless Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless communication using suitable mathematical models.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the basic elements of Cellular Radio Systems and its design

2.Learn about the concepts Digital communication through fading multipath channels

3.Understand various Multiple Access techniques for Wireless communication

4.Know about the Wireless standards and systems

Unit 1: Elements of Cellular Radio Systems Design: Basic cellular system, Performance criteria, Components and Operation of cellular systems, Planning a cellular system, Analog & Digital cellular systems, Concept of frequency reuse channels, Handoff: soft and hard handoff, Co-channel interference, Reduction factor, desired C/I for a normal case in an omni directional antenna system, Cell splitting, Wireless Channel characterization.

Unit 2: Digital Communication through fading multipath channels: Fading channels and their characteristics- Channel modelling, Digital signalling over a frequency non selective slowly fading channel. Concept of diversity branches and signal paths. Combining methods: Selective diversity combining, Switched combining, Maximal ratio combining, Equal gain combining.

Unit 3: Multiple Access Techniques for Wireless Communications: Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Basic concepts of Radio Protocols.

Unit 4: Wireless System standards & Emerging technologies: AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), IEEE Standards, Global system for Mobile (GSM): Services, Features, System Architecture and Channel Types, Frame Structure for GSM, Speech Processing in GSM, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications. CDMA Digital standard (IS 95): Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel, Wireless Cable Television, Bluetooth, Zigbee, LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

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Recommended Books:

1. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.
2. William C Y Lee, Mobile Cellular Telecommunications, 2nd Edition, MGH, 2004.
3. Raj Pandya, —Mobile and Personal Communication systems and services‖, Prentice Hall of India, 2001.
4. Wireless and Digital Communications; Dr. Kamilo Feher (PHI), 1998.

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BTCS-602-18	Credits	L	T	P	Int	Ext
Computer Networks	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Computer networking.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Explain the functions of the different layer of the OSI Protocol

2.Describe the function of each block of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs)

3.Develop the network programming for a given problem related TCP/IP protocol

4.Learn about DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Unit 1: Data Communication - Data Communication System & its Components, Representation of data and its flow Networks, Various Connection Topologies, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization.

Unit 2: Data Link Layer and Medium Access Sub Layer - Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP

Unit 3: Network Layer Switching - Logical addressing IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit 4: Transport and Application Layer - User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm, Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World wide web (WWW), HTTP, SNMP, Bluetooth, Firewalls, Introduction to network security.

Recommended Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill 2007.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India 2007.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition 2013.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India 2015.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, USA 2012 .

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UC-BTEC-603-19	Credits	L	T	P	Int	Ext
Optical Fibres and Communication	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the basics of Optical Communication and Optical fibres
2.Learn about the Optical Transmitters and Receivers
3.Explain the Light wave Architecture and systems
4.Ability to explain the modulation in Optical Communication

Unit 1: Introduction
Introduction to Telecommunications and fiber optics, Evolution of Light wave Systems, Need of Fiber Optic Communications, point to point systems and Networks, Information carrying capacity, Basic block diagram of fiber optic communication systems: Optical Communication Systems, Light wave System Components; Optical Fibers as a Communication Channel, Optical Transmitters, Optical Receivers.

Unit 2: Optical Fibers
Optical fiber description: How optical fiber conducts light, core cladding, Total internal reflection, Fiber Modes, Dispersion in Single-Mode Fibers, Modal dispersion, Step-Index Fibers, Graded Index Fibers, Understanding Numerical Aperture, Acceptance cone. Attenuation, bending losses, scattering, absorption, total attenuation, Bit rate and bandwidth, Cables, Connectors and Splicing.

Unit 3: Optical Sources and Detectors
Basic Concepts; Emission and Absorption concept in p-n Junctions, non-radiative Recombination, Semi-conductor Materials, Light Emitting Diodes; Light radiation by a semiconductor, Power-current Characteristics, LED Structures, Semi-Conductor Lasers Diodes; Principle of action, DFB Lasers, Coupled Cavity semiconductor Lasers, Vertical Cavity Semiconductor Lasers, Laser Characteristics. Basic concepts of detectors, p-n Photo Diodes, p-i-n Photo Diodes, Avalanche Photo Diode, Receiver Design, Receiver Noise; Noise mechanism, Receiver sensitivity; Bit error rate, Minimum Receiver Power.

Unit 4: Light Wave Systems
Overview: System Architecture, Components of fiber optic Networks, point to point links, Optical Amplifiers, Principle of operation, Wavelength Division Multiplexers and Demultiplexers, Semiconductor optical amplifiers, Erbium doped fiber amplifiers, Dispersion

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limited Light wave systems, Optical TDM Systems, Network Management and future of fiber optic Networks, Introduction to all optical networks.

Recommended Books:

1. Senior J. Optical Fiber Communications, Principles & Practice, PHI 1985.
2. Keiser G., Optical Fiber Communication, Mc Graw-hill 2008.
3. Govind P. Agrawal, Fiber Optics Communication Systems, John Wiley & Sons (Asia) Pvt. Ltd 1998.
4. Djafar K. Mynbeav, Fiber-Optics Communications Technology, Pearson 2001.

UC-BTEC-604-19	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Microwave and Antenna Engineering.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the working and operation of various Microwave Tubes and Microwave Solid-state devices.

2.Learn about various important Microwave Components and the Microwave measurements that can be carried out.

3.Explain the basic concepts and types of Antennas.

4.Describe the important concepts of Antenna Arrays and Antenna Aperture.

Unit 1: Microwave Tubes and Solid-State devices: Limitations of Conventional tubes, construction, Operation and properties of Klystron Amplifier, reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Backward Wave Oscillator (BWO), Crossed field amplifiers. Microwaves Transistors: (Bipolar, FET), Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT), Microwave Amplification by Stimulated Emission of Radiation (MASER).

Unit 2: Microwave Components and Measurements: Analysis of Microwave components using S-parameters, Junctions (E, H, Hybrid), Directional coupler, Bends and Corners, Microwave posts, S.S. tuners, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator), Cavity resonator, Matched termination. Power measurements using calorimeters and bolometers, Measurement of Standing Wave Ratio (SWR), Frequency and wavelength.

Unit 3: Antennas: Concept of Radiation in Single wire, Two wire, Dipole: Infinitesimal dipole, Short dipole, Monopole and half wave dipole; Introduction to Antenna parameters: Reflection Co-efficient, VSWR, Radiation pattern, Directivity, Gain; Far-field, Radiating near-field and reactive near-field region.

Unit 4: Antenna Arrays and Aperture Antennas: Array of two-point sources, Array factor, Array configurations, Hansen-woodyard end fire array, n-element linear array with uniform amplitude and spacing, n-element linear array with non-uniform spacing, Binomial and Dolph-Tschebysceff array, Scanning Arrays. Aperture Antennas, Horn antenna, Babinet's Principle, Slot Antenna, Loop antenna, Microstrip Patch.

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Recommended Books:

1. M.Kulkarni, Microwave and Radar Engineering, Umesh Publications, 5th Edition, 2018.
2. Jordan E.C., Electromagnetics and radiating systems, PHI 1995.
3. J.D.Krauss, Antenna Theory, McGraw Hill 1999.
4. C.A.Balanis, Antenna Theory, John Wiley & sons 4th Edition 2016.
5. R.L.Yadava, Antenna and wave propagation, PHI 2011

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UC-BTEC-902B-19	Credits	L	T	P	Int	Ext
Power Electronics	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to recall concepts of Power Electronics and understand the behaviour and working of power semiconductor devices using mathematical models.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Attain the ability and to handle the concept of construction and characteristics of Power semiconductor devices and fundamental of thyristors and family.
2. Demonstrate and build a various single phase AC-DC power converter circuits and understand their applications.
3. Illustrate the operating principle and construct a various types of DC-DC converters.
4. Simulate power electronic converters and their control scheme.

Unit 1: Power Semiconductor Devices

Construction and Characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs), Introduction to Thyristor family: SCR, DIACs, TRIACs, Light Activated SCRs (LASCRs), Reverse Conducting Thyristor , (RCT), Asymmetrical SCR (ASCR), Gate turn off Thyristors (GTOs), Integrated Gate Commutated Thyristors (IGCTs), MOS controlled Thyristors (MCTs) Power Integrated circuits (PICs), Intelligent Modules

Unit 2: Thyristor Fundamentals

Construction of SCR, Operating modes, Two transistor analogy, Static & dynamic characteristics, Gate characteristics, Turn on & turn off methods (Commutation methods), Series and Parallel operations of SCRs : Need, String efficiency, Issues, Static and Dynamic Equalizing circuit and Means to minimize the effect of mismatch Isolation of gate and base drive using pulse transformer and Opto-couplers, Gate Drive/Triggering circuits: R trigger, RC trigger, Cosine Triggering, UJT and Programmable UJT as an oscillator and triggering circuit based on them Ratings, Cooling and Heat sinks, Thermal Modeling, di/dt and dv/dt protection, Electro Magnetic Interference(EMI) and Shielding.

Unit 3: Phase Controlled (AC to DC) Converters

Review of half wave and full wave diode rectifier (with RL load); Principle of phase controlled converter operation; Operation of 1 phase half wave converter with R, RL and RLE load; Significance of freewheeling diode ; 1 phase full wave converter: Center tapped and Bridge Configuration; Operation and analysis with R,RL, RLE load; Analysis; 3 phase converters : Operation of half wave converter; Full wave fully controlled converters: Analysis and operation with different type of loads; Rectification and Inversion Mode;

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Semi controlled converter; Dual Converter: Principle and operation; 1 phase and 3 phase configurations; Simultaneous and Non simultaneous operation

Unit 4: DC Drives to DC Converters

The chopper, Basic principle of DC chopper, Classification of DC choppers, Control strategies, Basic DC-DC converter (switch regulator) topologies : Principle, operation and analysis for Step-down (Buck), Step-up (Boost), Step up/down (Buck-Boost), Continuous conduction and Discontinuous conduction operation, Basic characteristics of DC motors, Two zone operation, Four quadrant operation (Operating modes), Principles of DC motor speed control Single phase separately excited drives: Half Wave converter, Semi-converter and Fully Controlled converter based drives; Braking operation of separately excited drive. Principle of power control (motoring control) of separately excited and series motor with DC-DC Converter; Steady-state analysis

Recommended Books

1. M D Singh and K B Khanchandani, "Power electronics", TMH, New Delhi.
2. P.T. Krein, "Elements of Power Electronics"", Oxford University Press.
3. Muhammad H. Rashid, "Power Electronics Circuits, Devices and Applications", Prentice Hall of India, 3rd edition.
4. Ned Mohan, Undeland and Robbins, "Power Electronics Converters, Applications and Design", John Willey & sons.

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UC-BTEC-902C-19	Credits	L	T	P	Int	Ext
Mobile Adhoc Networks	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to explore various components of mobile adhoc networks with its Protocol Design and its security's importance.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Understand the principles of mobile ad hoc networks, and their models.
2. Understand and develop information dissemination protocols for mobile adhoc networks
3. Analyze the challenges in designing, routing and security in mobile adhoc networks.

Unit 1: Introduction to ad-hoc networks

Introduction, characteristics, features and applications of ad-hoc networks. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

Unit 2: Medium Access Protocols

Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Unit 3: Network Protocols

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

Unit 4: End Delivery, Security and Cross Layer Design

Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols. Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

Recommended Books

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach" 1st Edition, VPT, 2014
2. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc Network"
3. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
4. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M. bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

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UC-BTEC-902E-19	Credits	L	T	P	Int	Ext
Artificial Neural Networks	3	3	0	0	40	60

Course Objective

The objective of this course is to provide students with a basic understanding of the fundamentals and applications of artificial neural networks

Course Outcomes

At the end of this course students will demonstrate the ability to:

4. Understand generic machine learning terminology.
5. Understand the mathematical foundations of neural network models
6. Have a broad knowledge in Fuzzy logic principles and will be able to determine different methods of Defuzzification.

Unit 1: Fundamental Concepts of Artificial Neural Networks

Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all elarning rule, etc.

Unit 2: Single layer Perception Classifier

Classification model, Features & Decision regions; training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications.

Unit 3: Multi-layer Feed forward Networks

Linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, Generalized delta learning rule, Error back-propagation training, learning factors, Examples.

Unit 4: Associative memories

Linear Association, Basic Concepts of recurrent Auto associative memory: retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability.

Unit 5: Self organizing networks

UN supervised learning of clusters, winner-take-all learning, recall mode, Initialisation of weights, seperability limitations.

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Recommended Books

1. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
2. Neural Networks,Fuzzy Logic and Genetic Algorithms, by S.Rajasekaran and G.A. Vijayalakshmi Pai.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Machine Learning by Tom Mitchell, McGraw-Hill Press, 1997

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Open Elective - 1

(The List of Open Electives (OE) courses offered is provided in the Study Scheme)

BTEC-605-23	Credits	L	T	P	Int	Ext
Human Resource Management	3	3	0	0	40	60

Course Objective

This course deals with fundamental concepts of HR Management and system at various levels in general and in certain specific industries or organizations.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. To develop the understanding of the concept of human resource management and to understand its relevance in organizations.
2. To develop necessary skill set for application of various HR issues.
3. To analyze the strategic issues and strategies required to select and develop manpower resources.
4. To integrate the knowledge of HR concepts to take correct business decisions.

Unit 1: Introduction to Human Resource

Definition, Role and Functions of Human Resource Management, Concept and Significance of HR, Changing role of HR managers, HR functions and Global Environment, role of a HR Manager.

Unit 2: Human Resources Planning

Need and Process for Human Resource Planning, Methods of Recruitment, Planning Process, Planning at different levels, Recruitment and selection processes, Sources of Recruitment, Restructuring strategies, Placement and Induction, Retention of Employees.

Unit 3: Training and Development

Principles of Training, Employee Development, need for skill up gradation, Assessment of training needs, Retraining and Redeployment methods and techniques of training employees and executives, performance appraisal systems Career Development & Planning.

Unit 4: Job analysis (Design and Satisfaction) & Industrial relations

Job Analysis: Job Description & Job Specification, Job satisfaction and its importance; Motivation, Factors affecting motivation, introduction to Motivation Theory; Workers Participation, Quality of work life. Factors influencing industrial relations, Role of Trade unions.

Recommended Books

1. T.N.Chhabra- Human Resource Management (Dhanpat Rai & Co.).
2. Gary Dessler, Human Resource Management (8th ed.), Pearson Education, Delhi
3. Biswajeet Patanayak, Human Resource Management, PHI, New Delhi
4. A Minappa and M. S. Saiyada - Personnel Management (Tata Mc. Graw-Hill)

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UC-BTEC-611-19	Credits	L	T	P	Int	Ext
Optical Fibres and Communication Lab	1	0	0	2	30	20

Course Objective

This is one of the experimental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. To perform experiments based on optical communication in order to understand in depth concepts of latest communication system.
2. To study various types of optical sources and light detectors
3. To know methods of slicing and connecting techniques of optical fibres
4. To study different types of losses in optical fibres.
5. To know applications of optical fibres.

List of Experiments:

The student has to perform 8 to 10 Lab experiments from the below:

1. Study and measurement of Attenuation and Loss in optical fibre.
2. Study and measurement of bending loss in optical fibre.
3. Study and measurement of numerical aperture of optical fibre.
4. Measurement of optical power using optical power meter.
5. To Study the transmission of TDM signal through optical fibre.
6. To determine the bit rate of the optical fibre link.
7. Study of various multiplexing techniques.
8. To determine the BER of wireless system using M-ARY (BPSK,QPSK,8PSK,16PSK) and QAM technique.
9. To learn fibre splicing techniques and to become familiar with the use of optical time domain reflectometry in characterizing optical fibres.
10. To establish fibre optic analog link and to study the relationship between the input signal & received signal.
11. To study the VI characteristics of fibre optic source and Photo Detector.
12. Simulation of an optical communication system & calculation of its BER and Q factor using simulator.

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UC-BTEC-612-18	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of various types of Microwave components and important measurements related to Microwave and Antenna Engineering.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Learn about general Microwave components and Microwave bench.
2. Measure common parameters related to Microwave Components.
3. Determine frequency and wavelength of waveguides.
3. Measure and plot radiation patterns of various types of Antennas.

List of Experiments:

The student has to perform 8 to 10 Experiments from the below:

1. To study various Microwave Components and Instruments.
2. To study the V-I Characteristics of Gunn Diode Oscillator at X-band.
3. To study Output power and Frequency as a function of voltage using Gunn Diode Oscillator at X-band.
4. To Study the characteristics of a Reflex Klystron oscillator.
5. To determine the Standing Wave Ratio (SWR) and Voltage standing wave ratio (VSWR).
6. To measure the dielectric constant of a material at X-band.
7. To determine the frequency & wavelength in a rectangular waveguide.
8. Measurement of coupling factor and Isolation of a Directional coupler using X-band.
9. To measure the Attenuation/Insertion Loss of an attenuator.
10. Determination of the phase-shift of a phase shifter.
11. To plot the Radiation pattern of an antenna.
12. To study Simple Dipole ($\lambda/2$ or $\lambda/4$ or $3\lambda/2$) antenna (all or any of these single dipole antennas) and Folded Dipole $\lambda/2$ antenna.
13. To study 3/5/7-element Yagi-Uda Folded Dipole antenna.
14. To study the Radiation pattern, Gain, Directivity of a Slot/Loop Antenna.

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UC-BTEC-631-18	Credits	L	T	P	Int	Ext
Project – I	3	0	0	3	60	40

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

This is expected to provide a good initiation for the student(s) in R&D work. The assignment may normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

The students shall have to design two Projects (i.e. Project-I and Project-II in 6th Semester and 7th Semester, respectively). The projects must involve originality, innovation and business idea. Assessment will be based on the work performance & report submitted.

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BMPD-361-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development
The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

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SEVENTH/EIGHTH SEMESTER

B.Tech.

Electronics & Communication Engineering (ECE)

Syllabus

IKGujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

Professional Electives

BTEC-907A-18	Credits	L	T	P	Int	Ext
Internet Of Things (IOT) & Cloud Computing	3	3	0	0	40	60

Course Objective:
The main objective of this course is to enlighten the students with the basic concepts of Internet of Things (IoT) & Cloud Computing along with the services and application by their types which would facilitate to the humans to solve the real world problems.

Course Outcomes:
After completion of the course, the students would able to:
1. Understanding concept of cloud computing and analyze trade-off between deploying application on cloud and using local infrastructure
2. Identify issues and design challenges in IoT applications.
1. Select appropriate hardware and software components for IoT applications.
2. Conceptual knowledge will help students to build IOT applications.

Unit-I Introduction & Overview of Internet of things - The Internet of things today and tomorrow, Vision of internet of things, An IoT architecture outline ,Functional blocks of IOT ,industrial IOT, IOT enabled Smart devices in market, Application areas for IOT, Challenges in IOT. Hardware and Software tools required for IOT application development, Overview of IOT based on Texas instruments Hardware platforms and IDE's for development.

Unit- II Internet/Web and Networking Basics - Introduction to Internet & network topologies, TCP/IP protocol, TCP/IP Layers and their relative Protocols, IP addressing(IPV4), IP Address Classification & Subnetting, Local IP , Gateway IP and DNS,TCP & UDP Communication, Access point and Station model, Wireless networks, Encryption standards and signal strength of WiFi network, Overview of MAC Address, Energia WiFi Library API's .

Case Study : Connected microcontrollers essential to automation in buildings.

Unit-III Web servers and Client Communication- Introduction to a Web server and its types, Role of servers over internet, Port numbers, Socket Communication. WiFi Web Client, Client server Communication model with Example, Overview of HTTP protocol, HTTP based web server, Sensor interfacing with network, basics of HTML, Client and Server class API's.

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Unit-IV Cloud Communication in IOT- IOT device to cloud storage communication Model, need of Cloud services in IOT, ,Different Cloud storage services available today, Cloud Data processing and frame format, Role of Smart phones in IOT, Examples on Home automation and Smart city development, Introduction to clouds like Temboo, Blynk, Pubnub etc.

Case Study : Advances in bio-inspired sensing help people lead healthier lives.

Unit-V IOT Plate form and Application development- Remote Monitoring & Sensing, Remote Controlling, Application development using MQTT Protocol, Sensors and sensor Node and interfacing using Embedded target boards (TM4C123x & CC31xx), IoT applications in home, infrastructures, Healthcare, Transport, buildings, security, Industries, and other IoT electronic equipment, Adapting IPV6 for IOT Requirement (overview). •

Suggested Books

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrate Ecosystems, River Publishers 2010.
2. Jan Axelson, Embedded Ethernet And Internet Complete (Designing and Programming Small Devices for Networking) 2014.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach, McGraw Hill 2013.
4. Jean-Philippe Vasseur,Adam Dunkels, Morgan Kuffmann. Interconnecting Smart Objects with IP: The Next Internet,
5. Raj Kumar Buyya, James Broberg, Cloud Computing: Principles and paradigms 2000.
6. Barrie Sosinsky, Cloud Computing Bible, Wiley Publications 1999.
7. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Tata MacGrawHill 1997.

References

1. *http://www.ti.com/ww/en/internet_of_things/iot-overview.html.*
2. *http://energia.nu/reference/*
3. *Internet of Things (IoT): A vision, architectural elements, and future directions Jayavardhana Gubbia, Rajkumar Buyyab, *, Slaven Marusic a, Marimuthu Palaniswami a*
4. *http://www.ti.com/wireless-connectivity/simplelink-solutions/overview/overview.html.*
5. *https://www.hivemq.com/blog/mqtt-essentials-part2-publish-subscribe.*

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BTEC-907C-18	Credits	L	T	P	Int	Ext
Robotics and Embedded Systems	3	3	0	0	40	60

Course Objective:

The main objective of this course is to enlighten the students with the basic fundamentals of Robotics, Robotic Transformation, Simulation and programming along with the Embedded systems in Robotics so that they will be able to design the robots which would facilitate to the humans to solve the real world problems.

1. Ability to understand basic concept of robotics.
2. To analyze Instrumentation systems and their applications to various
3. To know about the differential motion, add statics in robotics
4. To know about the various path planning techniques.
5. To know about the dynamics and control in robotics industries.

UNIT I - BASIC CONCEPTS

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors-work cell-Programming languages.

UNIT II - DIRECT AND INVERSE KINEMATICS

Mathematical representation of Robots-Position and orientation–Homogeneous Transformation-Various Joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct Kinematics-Inverse kinematics-SCARA robots-Solvability–Solution Methods-Closed form solution.

UNIT III - MANIPULATOR DIFFERENTIAL MOTION AND STATICS

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.

UNIT IV - PATH PLANNING

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric Descriptions-Straight line and circular paths-Position and orientation planning.

UNIT V - ROBOTICS SYSTEM DESIGN

Running Code on Microcontroller-Voltage, Current and power-ARM Cortex M-Software Design-Battery and Voltage Regulation-GPIO-Interfacing Input and Output-DC Motors-Timers-Bluetooth Low Energy.

Suggested Books:

1.R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2.JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-HillSingapore, 1996.
4. Jonathan W. Valvano, Embedded Systems: Introduction to Robotics, First Edition,2019
5. TI Robotic System Design Lab-RSLK (https://university.ti.com/en/faculty/ti-robotics-system-learning-kit/ti-robotics-system-learning-kit)

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BTEC-908C-18	Credits	L	T	P	Int	Ext
VLSI Design	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of VLSI Design and its concepts.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concepts and various processes related to VLSI
2. Understand the VLSI Circuit Design processes and Gate level design
3. Learn about VHDL Synthesis and the tools involved
4. Describe about CMOS Testing techniques

Unit 1: Introduction to VLSI & Basic Electrical properties - IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Oxidation, Lithography, Diffusion, Ion implantation, Metallisation, Encapsulation Probe testing, Integrated Resistors and Capacitors. Electrical Properties of MOS and BiCMOS Circuits: I_{ds}-V_{ds} relationships, MOS transistor threshold Voltage, Body effect, g_m, g_{ds}, Figure of merit, Pass-transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Invertor.

Unit 2: VLSI Circuit Design Processes - VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Unit 3: Gate Level Design - Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations: Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-In/Fan-out.

Unit 4: VHDL Synthesis - VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools, Test Principles.

Unit 5: CMOS TESTING – Design for manufacturability, Introduction to CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Recommended Books:

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1.Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition.

2. CMOS Digital Integrated Circuits Analysis & Design, S M Kang and Y Leblebici, McGraaw-Hill, Third Edition.

3.Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.

4.Chip Design for Submicron VLSI: CMOS Layout & Simulation, – John P. Uyemura, Thomson Learning.

5.Introduction to VLSI Circuits and Systems – John .P. Uyemura, JohnWiley, 2003.

6.Digital Integrated Circuits – John M. Rabaey, PHI, EEE, 1997.

7.Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.

8. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

BTEC-909B-18	Credits	L	T	P	Int	Ext
Information Theory and Coding	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and importance with understanding of Information Theory and Coding along with coding techniques.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

Unit 1 – Basic Concepts of Information Theory: The concept of Amount of Information, Average Information, Entropy, Information rate, Shannon's Theorem, Mutual information; Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth - S/N Trade-off, Introduction to Channel Capacity & Coding, Channel Models, Channel Capacity Theorem, Shannon Limit. Huffman source coding algorithm, Lempel Ziv source coding algorithm.

Unit 2 - Introduction to Error Control Coding: Linear Block Codes: Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, Hamming Code. Cyclic Codes: Description of Cyclic codes, Generator and parity check matrices of cyclic codes, error detection decoding of cyclic codes. BCH Codes: Description of codes, Decoding of BCH codes, Implementation of error connection.

Unit 3 - Convolution Codes: Encoding of convolution codes, structural properties of Convolution codes, Distance Properties of convolution codes. Automatic Repeat Request Strategies: Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes.

Unit 4- Error Control Coding: Concatenated Codes and Turbo Codes, Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Text/Reference Books:

- 1. N. Abramson, Information and Coding, McGraw Hill, 1963.
- 2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
- 3. R.B. Ash, Information Theory, Prentice Hall, 1970.
- 4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
- Ranjan Bose, Information Theory, Coding and Cryptography, The McGraw Hill, 2007.
- Related IEEE/IEE Publications

BTEC-909C-18	Credits	L	T	P	Int	Ext
Embedded System Design	3	3	0	0	40	60

Course Objectives

This course deals with the concepts and design requirements for understanding the Embedded System Design and its fundamentals.

Course Outcomes

After the completion of this course, the student will be able to

- Learn about the basic architecture of 32-bit microcontrollers
- Understand hardware interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.
- Reviews and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.
- Understand Embedded Networking concepts based upon connected MCUs

UNIT-I: Introduction to Embedded systems

Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. Fixed point and Floating point arithmetic operations.

Introduction ARM architecture and Cortex – M series, Introduction to the Tiva family viz. TM4C123x(Cortex M4F) and its targeted applications, block diagram, address space, on-chip peripherals (Analog and Digital) Register sets, Addressing modes and instruction set basics.

UNIT-II: Microcontroller Fundamentals for Basic Programming

I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Introduction to Interrupts, Interrupt vector table, interrupt programming.

UNIT- III: Timers, PWM and Mixed Signals Processing

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

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UNIT-IV: Communication protocols and Interfacing with external devices

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol. Implementing and programming I2C, SPI & UART interface and CAN & USB interfaces on TM4C123x .

UNIT V: Embedded networking

Embedded Networking fundamentals, Ethernet, TCP/IP introduction, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi.

Recommended Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

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BTEC-909E-18	Credits	L	T	P	Int	Ext
Biomedical Signal Processing	3	3	0	0	40	60

Course Objectives

The main objective of this course is to enlighten the students with the basic fundamentals and concepts of Biomedical Signal Processing.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the fundamentals of signal processing for various bio-signal analysis
2. Learn the Infinite impulse response (IIR) filter and study its applications
3. Attain in-depth knowledge about the basic concepts of finite impulse response (FIR) filter and study its applications
4. Apply different methods of signal processing techniques in analyzing the various bio-signals such as Electro cardiogram (ECG), Electro myogram (EMG) and Phonocardiogram (PCG)

Unit 1: Fundamentals of Biomedical Signal Processing (BSP) - Different types of Bioelectric signals and its basic characteristics, Sampling and aliasing, simple signal conversion systems, spectral analysis, FFT - Decimation in Time algorithm and Frequency algorithm.

Unit 2: IIR and FIR Digital Filter Design and Application - Characteristics of IIR and FIR filters, Impulse invariant method, Design of Bilinear transformation and Impulse invariant method using Butterworth technique, Design of Bilinear transformation and Impulse invariant method using Chebyshev technique, Warping and pre-warping effect, Fequency transformation, FIR filter design using windowing techniques- Rectangular, Hamming, Hanning, Blackmann Windows, Time domain filters- synchronized averaging, moving average filters.

Unit 3: Analysis of Bio-Signals for Signal Processing - P-Wave detection, QRS complex detection-derivative based method, Pan Tompkins algorithm, Template matching method, Signal averaged ECG, Analysis of heart rate variability-time domain method and frequency domain methods, Synchronized averaging of PCG envelopes, Envelogram, analysis of PCG signal, EMG signal analysis, ECG rhythm analysis, normal and ectopic ECG beats, analysis of exercise ECG, Analysis of respiration, spectral analysis of EEG signals. Multimedia Applications.

Recommended Books:

1.Rangaraj.M.Rangayyan, Biomedical signal processing, Wiley-IEEE press, 2nd edition, 2015.
2.S.Salivahnan, C.Gnanapriya, Digital signal processing, Tata McGraw-Hill, New Delhi, 2nd edition 2011.
3.John G. Proakis and DimitrisG Manolakis, Digital signal processing, algorithms and applications, PHI of India Ltd., New Delhi, 4th edition, 2007.
4.Reddy D.C, Biomedical signal processing: Principles and techniques, Tata McGraw-Hill, New Delhi, 2nd edition, 2005.

BTEC-907B-18	Credits	L	T	P	Int	Ext
Antenna Radiating Systems	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of Antenna Radiating Systems and its fundamentals.

Course Outcomes

At the end of the course, students will demonstrate the ability

- To understand the basic concepts of radiation.
- To understand various antenna types.
- To analyse the radiation pattern of antenna arrays.
- To understand the concept of various wave propagation techniques.
- To understand the concept of radiating systems on environment.

Unit 1: Antenna Fundamentals - Power density, directivity, gain, radiation resistance, input impedance, radiation patterns, beam width, bandwidth and polarization. Retarded potential, Matching – Baluns, Polarization mismatch, Antenna noise temperature & SNR, Linear and array antennas - Arrays of two point sources – Broad side and end fire arrays, binomial array - Principle of pattern multiplication –Adaptive arrays.

Unit 2: Fundamentals of Radiation - Radiation from a current element and monopole – Radiation from a Quarter-wave dipole, half-wave and centre-fed dipole – Near and far fields, current distribution of dipole antennas. Radiation from oscillating dipole, Half wave dipole, Folded dipole. Radiation through an Aperture, Radiation from Electromagnetic Horns.

Unit 3: Special Purpose Antennas: (Qualitative treatment only) Loop antennas, Travelling wave antennas, V and rhombic antennas, Horn antennas, Yagi-Uda arrays, Wideband antennas, Log periodic antennas. Babinet's principle – Slot radiators- Parabolic reflectors – Radiation pattern, aperture efficiencies – Feeding techniques for parabolic antennas.

Unit 4: Antenna Measurements - Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods).

Unit 5: Environmental effects - Concept of Electromagnetic interference (EMI); EMC and its advantages. effect of radiating systems on environment, techniques to suppress EMI.

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Recommended Books:

1. Constantine A. Balanis, Antenna Theory: Antenna & Design 4th Edition, 2016, Wiley.
2. A. R. Harish, M. Sachidananda, Antennas and Wave Propogation, 2011, Oxford University Press.
3. Edward Conrad Jordan and Keith George Balmain, Electromagnetic Waves and Radiating Systems, PHI.
4. R.L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi.
5. A. Das, Sisir K. Das, Microwave Engineering, Tata McGraw Hill.
6. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, Antennas and Wave Propagation, Fourth Edition, 1980, Tata McGraw Hill.

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BTEC-908A-18	Credits	L	T	P	Int	Ext
Artificial Intelligence	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Artificial Intelligence Networks, Systems, Methods and parameters.

Course Outcomes

At the end of this course students will demonstrate the ability to:

- Learn about the basic understanding of Artificial Intelligent system
- explain about various types of Artificial Neural Networks & their models
- describe Artificial Neural networks methods, operation and parameters
- explore Neural Network MATLAB Toolbox

Unit 1 - Introduction

Approaches to intelligent control, Architecture of intelligent control, Linguistic reasoning, Rulebase, Knowledge representation.

Unit 2 - Artificial Neural Networks

Biological neuron, Artificial Neural Network (ANN), Mathematical Models, McCulloch Neural Model, Perceptron, Adaline and Madaline, Learning & Training in ANN, Hopfield Neural Network, Self Organizing Networks, Recurrent Networks, Associative memories.

Unit 3 - Fuzzy Logic System

Crisp Vs Fuzzy set theory, Membership functions, Fuzzy set operations, Fuzzy rules, Mamdani and Sugeno fuzzy inference systems, Defuzzification methods.

Unit 4 – ANN Methods and Parameters

Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities.

Unit 5 – Fuzzy Logic MATLAB Toolbox

Fuzzy Logic Toolbox, Neural Network Toolbox, FLS for Antilock Breaking System (ABS), GA in route planning for Travelling Sales Person, Time-Series forecasting using ANN.

Recommended Books

1. Jacek M. Zurada - Introduction to Artificial Neural Systems, PWS Publishing Company 1995.
2. S N Sivanandam, S N Deepa - Principles of Soft Computing, Wiley Publications, 2007.
3. John Yen, Reza Langari - Fuzzy Logic Intelligence, Control, and Information, Pearson 1998.

BTEC-908F-19	Credits	L	T	P	Int	Ext
Wireless Sensor Networks	3	3	0	0	40	60

Course Objective

To enable students, familiarize with Wireless sensor networks, its constraints and protocols.

Course Outcomes

After the completion of the course, the student will be able to:

1. Gain insights of Wireless Sensor Network (WSN) background, its challenges, constraints along with its advantages and applications.
2. Know the architecture of WSN and its sub-systems.
3. Explain node structure along with the technologies used in WSN.
4. Study various Wireless Propagation Models and discuss the various MAC protocols, communication protocols and routing protocols.

Unit I Introduction: Introduction to Wireless sensor networks, Definitions and background, Challenges and constraints, Single-sink single-hop WSN, Single-sink multi-hop WSN, Multi-sink multi-hop WSN, Advantages of sensor networks.

Unit II Node Structure: Introduction: Sensing and Processor Subsystems, Architectural Overview, Application-specific Integrated Circuit, Field Programmable Gate Array, Comparison Communication Interfaces, Serial Peripheral Interface, Inter-Integrated Circuit, Prototypes, The IMote Node Architecture, The XYZ Node Architecture.

Unit III Physical Layer: Introduction to Wireless Propagation Models: The Free Space Propagation Model, The Two-Ray Ground Model, The Log-Distance Path Model, Energy Dissipation Model, Error Models: The Independent Error Model, Two-State Markov Error Model, Sensing Models: Binary and Probabilistic Sensing Models.

Unit IV WSN Protocols and Technologies: MAC protocols, Issues in designing routing protocols, Classification of routing protocols, Flat routing, Flooding and gossiping, SPIN protocol, Directed diffusion protocol, Rumour routing, Location-based routing protocols. WSN application to ZigBee technology, Ultrawide bandwidth technology, Bluetooth technology, Comparison among technologies

Unit V Applications of WSNs: Entertainment and Consumer Electronics, Logistics, Transportation, Industrial Control and Monitoring, Home Automation, Security and Military Sensing, Intelligent Agriculture and Environmental monitoring, Health Monitoring.

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Recommended Books

- Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley Inter Science 2017
- Edgar H. Callaway, Wireless Sensor Networks: Architectures and Protocols, Jr. Auerbach Publications, CRC Press 2016
- C. S Raghavendra, Krishna M, Sivalingam, Taieb Znati, Wireless Sensor Networks, Springer 2011
- Bhaskar Krismachari, Networking Wireless Sensors, Cambridge University Press 2005
- Victor Lesser, Charles L. Ortiz, Milind Tambe, Distributed Sensor Networks: A Multiagent Perspective, Kluwer Publications 2009
- T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

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BTEC-907D-18	Credits	L	T	P	Int	Ext
Python Programming	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Python programming, its functions & the concept of Eratosthenes.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Read and write simple Python programs.
2. Develop Python programs with conditionals and loops.
3. Define Python functions and to use Python data structures–lists, tuples, dictionaries.
4. Perform input/output operations with files in Python.
5. Execute Searching, sorting and merging in Python.

Unit I: Introduction - The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit 2: Functions - Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. String: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries Higher Order Functions: Treat functions as first class Objects, Lambda Expressions.

Unit 3: Sieve of Eratosthenes - Generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O: File input and output operations in Python Programming Exceptions and Assertions

Unit 4: Modules and Classes - Modules: Introduction, Importing Modules, Abstract Data Types: Abstract data types and ADT interface in Python Programming. Classes: Class definition and other operations in the classes, Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.), Class Example, Inheritance, Inheritance and OOP.

Recommended Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/OReilly Publishers, 2016.
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,,2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programsl, CENGAGE Learning, 2012.
7. Charles Dierbach, Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

BTEC-909D-18	Credits	L	T	P	Int	Ext
Artificial Intelligence & Machine Learning	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of Artificial Intelligence (AI) and Machine Learning and its issues, challenges and fundamentals. The course actually possesses the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and Machine Learning.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. To learn the difference between optimal reasoning Vs human like reasoning
2. To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3. To learn different knowledge representation techniques
4. To understand the applications of AI namely, Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

Unit –I: Foundations of AI and Intelligent Agents: What is AI, History of AI, Strong and weak AI, The State of the Art. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit –II: Basic AI Concepts and Machine Learning: Boolean Algebra, Expert Systems, Configuration of Device, Introduction to SWI Prolog, Installing prolog, Introduction to Fuzzy Logic, Basic of ML, Colour Selection Algorithm.

Unit –III: Solving Problems by Searching: Problem –Solving Agents, Example Problems, Searching for Solutions, uniformed search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Unit –IV: Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit –V: Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Learner Models, Nonparametric Models, Support Vector Machines, Ensemble Learning, Practical Machine Learning.

Suggested Text Books:

1."Artificial Intelligence A Modern Approach", Stuart J. Russell & Peter Norvig –Pearson.
2."Artificial Intelligence", Elaine Rich, Kevin Knight & Shivashankar B Nair –McGraw Hill Education.
3.Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier
4. T. Hastie, R. Tibshirani, J. Friedman ---The Elements of Statistical Learning, 2e, 2008.

5. C. Bishop --- Pattern Recognition and Machine Learning. 2e 2010.
6. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
7. E. Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
8. S. Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press.

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BTEC-907E-18	Credits	L	T	P	Int	Ext
Adaptive Signal Processing	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Adaptive Signal Processing and related algorithms.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the non-linear control and the need and significance of changing the control parameters with respect to real-time situation.
2. Mathematically represent the 'adaptability requirement'.
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

Unit 1: General concepts of Adaptive Signal Processing – General Aspects of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 2: Adaptive Signal Processing Algorithms - Optimal (Wiener) filter, Method of steepest descent, extension to complex valued, LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Unit 3: Signal space concepts - introduction to finite dimensional vectors pace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram- Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces. Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 4: Introduction to recursive least squares (RLS) - vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Recommended Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
3. Alexender Thomas 1984/86.

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BTEC-908D-18	Credits	L	T	P	Int	Ext
Soft Computing	3	3	0	0	40	60

Course Objectives

The main objective of this course is to enlighten the students with the basic fundamentals and concepts of Soft Computing and Algorithms.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concepts of Soft Computing and Algorithms involved there-in
2. Understand Genetic Algorithms with its operators and applications
3. Learn about the Neural Network models and its applications
4. Describe the Fuzzy systems and Swarm Intelligence

Unit 1: Introduction - What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing. Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

Unit 2: Neural Networks- Concept, biological neural system,. Evolution of neural network, McCullochPitts neuron model, activation functions, feed forward and feedback networks, learning rules – Hebbian, Delta, Perceptron learning and Windrow-Hoff,winner-take-all. Supervised learning- Perceptron learning, single layer/multilayer perceptron, Adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, Application of Neural networks in Image processing.

Unit 3: Fuzzy systems - Basic Definition and Terminology, Set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification.

Unit 4: Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Recommended Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley. ISBN13: 9788126527410, 2011.

2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", PrenticeHall of India, 2003.

3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.

4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.

5. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.

6. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

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BTEC-909A-18	Credits	L	T	P	Int	Ext
Introduction to Big Data	3	3	0	0	40	60

Course Objectives

This course deals with knowledge of fundamentals, architecture and concepts for better understanding of Introduction of Big Data.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the Evolution and basics of Big Data.
2. Understand the Architecture of Hadoop with its file system and its Programming.
3. Explain the Advanced analytical theory and methods.
4. Describe the challenges in handling streaming data from the real world.

Unit 1 - Evolution & Introduction to Big data: Best Practices for Big data Analytics, Big data characteristics, Validating – The Promotion of the Value of Big Data, Big Data Use Cases, Characteristics of Big Data Applications, Perception and Quantification of Value, Understanding Big Data Storage.

Unit 2 - A General Overview of High Performance Architecture: HDFS, Map Reduce and YARN – Map Reduce Programming Model. Big Data Overview Analysis of data at Rest- Hadoop analytics: Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Hadoop cluster components, Hadoop Ecosystem, Evaluation criteria for distributed Map Reduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation

Unit 3 - Advanced Analytical Theory and Methods: Overview of Clustering – K-means, Use Cases, Overview of the Method, Determining the Number of Clusters, Clustering, Classification, Segmentation, Linear regression, ML Search: Indexing and Indexing Techniques, Create inverted index using JAQL, Data Explorer Bundling Hadoop job: Application, Diagnostics, Reasons to Choose and Cautions, Classification: Decision Trees, Overview of a Decision Tree, The General Algorithm – Decision Tree Algorithms, Evaluating a Decision Tree

Unit 4 - Real time analytics: Introduction to streams computing, Challenges/limitations of conventional Systems, Solving a real time analytics problem using conventional system, Challenges to be solved - scalability, thread pooling, etc., Understanding the challenges in handling streaming data from the real world and how to address those using stream computing, Benefits of stream computing in Big Data world, Realtime Analytics Platform (RTAP), Real Time Sentiment Analysis.

Recommended Books:

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Chris Eaton, Paul Zikopoulos, Wiley Publication 2015.
2. Big Data Analytics: Turning Big Data into Big Money By Frank J. Ohlhorst, McGraw Hill 2012.
3. Ethics of Big Data: Balancing Risk and Innovation By Kord Davis, 2011.
4. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends, By Michael Minelli, Michele Chambers, Ambiga Dhiraj, Wiley Publication 2013.

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BTEC-908E-18	Credits	L	T	P	Int	Ext
Digital Image and Video Processing	3	3	0	0	40	60

Course Objectives

This course deals with the concept, knowledge and background required for better understanding of Digital Image and Video Processing.

Course Outcomes At the end of this course students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding.

Unit 1: Digital Image Fundamentals - Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit 2: Color Image Processing - Color models–RGB, YUV, HSI; Color transformations– formulation, Color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Image Segmentation - Detection of discontinuities, edge linking and boundary detection, region-based segmentation. Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, Continuous wavelet transforms, Wavelet bases and multi-resolution analysis, Wavelets and Sub band filter banks, Wavelet packets. Image Compression-Redundancy–inter-pixel and psycho-visual; Still image compression standards – JPEG and JPEG-2000.

Unit 3: Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Unit 4: Video Segmentation- Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Recommended Books:

1.R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008.
2.Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.
3. Murat Tekalp, Digital Video Processing" Prentice Hall, 2nd edition 2015.

Open Elective – 2

(The List of Open Electives (OE) courses offered is provided in the Study Scheme)

BTOEC-701-23	Credits	L	T	P	Int	Ext
ENTREPRENEURSHIP	3	3	0	0	40	60

Course Objective

This course deals with fundamental concept to encourage students and help them imbibe an entrepreneurial mind-set & to focus on specific skills requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready.

Course Outcomes

At the end of this course student will demonstrate the ability to:

5. Apply knowledge about entrepreneurship and successful entrepreneurs.
6. Develop an entrepreneurial mind-set by learning key skills such as design.
7. Understand the concept of personal selling and communication.
8. Understand the traits of an entrepreneur and assess their strengths and weaknesses from an
   entrepreneurial perspective.
9. Understand various types of business organizations

Unit 1: Introduction to Entrepreneurship

Meaning and concept of entrepreneurship, role of entrepreneurship in economic development, Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship, types of entrepreneurs, EQ vs IQ: how they differ.

Unit 2: The Entrepreneur

Why to become entrepreneur, the skills/ traits required to be an entrepreneur, Creative and Design Thinking, the entrepreneurial decision process, skill gap analysis, and role models, mentors and support system, entrepreneurial success stories.

Unit 3: Communication

Importance of communication, barriers and gateways to communication, listening to people, the power of talk, personal selling, risk taking & resilience, negotiation.

Unit- IV: Business Organization & E-cell

Introduction to various form of business organization, mission, vision and strategy formulation. Meaning and concept of Entrepreneurship-cell (E-cell)

Recommended Books

1.Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill

2.Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India

3.A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009\

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Open Elective - 3

(The List of Open Electives (OE) courses offered is provided in the Study Scheme)

Mandatory Courses

The syllabus of these courses is on the lines of AICTE Model Curriculum 2018

BTMC-101-18	Credits	L	T	P	Int	Ext
Indian Constitution	Non-credit	3	0	0	40	60

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does nottruly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1 Meaning of the constitution law and constitutionalism

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2 Historical perspective of the Constitution of India
3 Salient features and characteristics of the Constitution of India
4 Scheme of the fundamental rights
5 The scheme of the Fundamental Duties and its legal status
6 The Directive Principles of State Policy–Its importance and implementation
7 Federal structure and distribution of legislative and financial powers between the Union and the States
8 Parliamentary Form of Government in India – The constitution powers and status of the President of India
9 Amendment of the Constitutional Powers and Procedure
10 The historical perspectives of the constitutional amendments in India
11 Emergency Provisions : National Emergency, President Rule, Financial Emergency
12 Local Self Government – Constitutional Scheme in India
13 Scheme of the Fundamental Right to Equality
14 Scheme of the Fundamental Right to certain Freedom under Article19
15 Scope of the Right to Life and Personal Liberty under Article21

Course Objectives: The objective of the course is to provide the basic knowledge about the Political System of the Country. The basic idea is to make the students aware of their duties and rights. Apart from it the course will aim to educate the pupils about the working of different organs of the government, various constitutional bodies and the agencies of the government. In addition to it, students will be given brief knowledge regarding the different challenges of Indian Political System, forms of Government in India and nature & dimensions of Indian Federal System. Course Pedagogy: Since the course is of Practical Importance, it is recommended that during the course students will be taken out for one visit to any place with the potential of imparting practical knowledge to the students about the Indian Political System. Such places can be Indian Parliament. State Legislative Assembly, Youth Parliament Pune. It is expected that students should be given case studies about the Indian Political System and Debates on Constitutional Issues should be organised in the campus.

Course Outcome: After the successful completion of the course students will be to understand the different dimensions of Indian Political System. They will be aware about their duties towards the fellow citizens. Students will be able to challenges of the democratic institutions and theoretical aspects of the state and its organs.

Suggested Reading:

1. Indian Political System by J C Johri
2. Indian Political System by Mahendra Prasad Singh
3. Fundamentals of Indian Political System by Rajesh K Jha.
4. Our Constitution by Subhash C Kashyap
5. Our Political System by Subhash C Kashyap
6. Indian Federalism – An Introduction by Mahendra Prasad Singh
7. Indian Federalism and Autonomy by S Chandrasekhar

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BTMC-102-18	Credits	L	T	P	Int	Ext
Essence of Indian Traditional Knowledge	Non-credit	3	0	0	40	60

Part-1 Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions.

Part-1 focuses on introduction to Indian Knowledge System. Indian perspective of modern scientific world -view and basis principal of Yoga and holistic health care system.

Course Outcomes

-Ability to understand connect up and explain basics of Indian traditional Knowledge in Modern scientific perspective.
-Ability to understand connects up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

Course contents

ii. Basic Structure of Indian Knowledge system
iii. ii. Modern Science and Indian Knowledge system
iv. Yoga and Holistic Health Care
v. iv. Case studies

References

- Fritz of Capra Too of Physics
- Fritz of Capra The Wave of life
- Yoga Sutra of Patanjali. Ramakrishna Mission. Kolkata.
- RN Jha Science of Consciousness Psychotherapy and Yoga Practices. Vidyanidhi Prakashan. Delhi2016
- PB Sharma (English translation) Shodashang Hridayam

Pedagogy: Problem based learning, group discussion, collaborative mini projects

Part-2 Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions

Part-2 focuses on Indian philosophical traditions. Indian linguistic Tradition, and Indian artistic tradition.

Course contents

ii. Philosophical Tradition
iii. Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
iv. Indian Artistic Tradition
v. Case studies

References

• V.Sivaramakrishnan (Ed.), Cultural Heritage of India-Course material, Bhartiya Vaidya Bhawan Mumbai 5th Edition 2014
• S.C Chaterjee &D.M .Datta , An introduction to Indian Philosophy ,University of Calcutta 1984.
• KS Subrahmanialyer ,Vakyapadiya of Bhattaraihari (Brahma Kanda), Deccan College Pune 1965
• VN Jha, Language Thought and Reality
• Pramod Chandra. India Arts Howard Univ. Press 1983
• Krishna Chaitanya Arts of India. Abhinav Publications. 1987
• R Nagaswamy , Foundations of Indian Art Tamil Arts Academy.2002

Pedagogy: Problem based learning, group discussion, collaborative mini projects

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UC-BTEC-731-18	Credits	L	T	P	Int	Ext
Project Stage - II	6	0	0	12	120	80

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up during Project-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Prototyping or Product development/Patent and Video demonstration;
6. Preparing a paper for Conference presentation/Publication in Journals;
7. Preparing a Dissertation in the standard format for being evaluated by the Department;
8. Final Seminar Presentation before a Departmental Committee.

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BMPD-371-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development
The objective of mentoring will be development of:
- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty in charges shall maintain proper record student wise of each activity conducted
and the same shall be submitted to the department.

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Scheme & Syllabus of

Bachelor of Technology

Computer Science Engg. (Artificial Intelligence & Machine Learning)

Batch 2020 onwards (3rd -8th Semester)

By

Department of Academics

IK Gujral Punjab Technical University

Head

Bachelor of Technology in Computer Science Engg. (AI & ML)

It is a Graduate (UG) Programme of 4 years duration (8 semesters)

Courses & Examination

Scheme: Third Semester

Course Code	Type of Course	Course Title	Hours per Week			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTES 301-18	Engineering Science Course	Digital Electronics	3	0	0	40	60	100	3
BTCS 301-18	Professional Core Courses	Data structure & Algorithms	3	0	0	40	60	100	3
BTCS 302-18	Professional Core Courses	Object Oriented Programming	3	0	0	40	60	100	3
BTAM 304-18	Basic Science Course	Mathematics-III	3	0	0	40	60	100	3
HSMC 101/102-18	Humanities & Social Sciences Including Management \Courses	Foundation Course in Humanities (Development of Societies/Philosophy)	2	1	0	40	60	100	3
BTES 302-18	Engineering Science Course	Digital Electronics Lab	0	0	2	30	20	50	1
BTCS 303-18	Professional Core Courses	Data structure & Algorithms Lab	0	0	4	30	20	50	2
BTCS 304-18	Professional Core Courses	Object Oriented Programming lab.	0	0	4	30	20	50	2
BTCS 305-18	Professional Core Courses	IT Workshop*	0	0	2	30	20	50	1
		Summer Institutional Training	0	0	0	0	0	0	Satisfactory/Unsatisfactory
Total			**14**	**1**	**12**	**320**	**380**	**700**	**21**

*Syllabus to be decided by respective institute internally. It may include latest technologies.

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Fourth Semester

Course Code	Type of Course	Course Title	Hours per Week			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCS 401-18	Professional Core Courses	Discrete Mathematics	3	1	0	40	60	100	4
BTES 401-18	Engineering Science Course	Computer Organization & Architecture	3	0	0	40	60	100	3
BTCS 402-18	Professional Core Courses	Operating Systems	3	0	0	40	60	100	3
BTCS 403-18	Professional Core Courses	Design & Analysis of Algorithms	3	0	0	40	60	100	3
HSMC 122-18	Humanities & Social Sciences including Management Courses	Universal Human Values 2	2	1	0	40	60	100	3
EVS101-18	Mandatory Courses	Environmental Sciences	3	-	-	100	-	100	S/US
BTES 402-18	Engineering Science Course	Computer Organization & Architecture Lab	0	0	2	30	20	50	1
BTCS 404-18	Professional Core Courses	Operating Systems Lab	0	0	4	30	20	50	2
BTCS 405-18	Professional Core Courses	Design & Analysis of Algorithms Lab	0	0	4	30	20	50	2
Total			**15**	**2**	**10**	**390**	**360**	**750**	**24**

Students will take up summer internship of 4-6 weeks at industry or organizations of repute after 4th sem, that will be accredited in 5th semester.

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Fifth Semester

Course Code	Type of Course	Course Title	Hours per Week			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTES 501-20	Engineering Science	Statistical Computing Techniques using R	3	0	0	40	60	100	3
BTCS 501-18	Professional Core Courses	Database Management Systems	3	0	0	40	60	100	3
BTCS 502-18	Professional Core Courses	Formal Language & Automata Theory	3	0	0	40	60	100	3
BTAIML 501-20	Professional Core Courses	Programming in Python	3	0	0	40	60	100	3
BTAIML 502-20	Professional Core Courses	Artificial Intelligence	3	0	0	40	60	100	3
BTAIML *****	Professional Elective	Elective-I	3	0	0	40	60	100	3
MC	Mandatory Courses	Constitution of India/ Essence of Indian Traditional Knowledge	2	-	-	100	-	100	S/US
BTES 502-20	Engineering Science	Statistical Computing Techniques using R lab	0	0	2	30	20	50	1
BTCS 505-18	Professional Core Courses	Database Management Systems lab	0	0	2	30	20	50	1
BTAIML 503-20	Professional Core Courses	Programming in Python Lab	0	0	2	30	20	50	1
BTAIML 504-20	Professional Core Courses	Artificial Intelligence Lab	0	0	2	30	20	50	1
BTAIML *****	Professional Elective	Elective-I Lab	0	0	2	30	20	50	1
	Professional Training	Industrial *Training	-	-	-	60	40	100	S/US
Total			**20**	**0**	**10**	**460**	**440**	**900**	**23**

* 4-6 weeks industrial training undertaken after 4th semester in summer vacations.

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Sixth Semester

Course Code	Type of Course	Course Title	Hours per Week			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCS 504-18	Professional Core Courses	Computer Networks	3	0	0	40	60	100	3
BTCS 619-18	Professional Core Courses	Machine Learning	3	0	0	40	60	100	3
BT* UUU-18	Professional Elective Courses	Elective-II	3	0	0	40	60	100	3
BT* YYY-18	Professional Elective Courses	Elective-III	3	0	0	40	60	100	3
BTOE ***	Open Elective Courses	Open Elective-I	3	0	0	40	60	100	3
BTCS 603-18	Project	Project-1	0	0	6	60	40	100	3
BTCS 507-18	Professional Core Courses	Computer Networks Lab	0	0	2	30	20	50	1
BTCS 620-18	Professional Core Courses	Machine Learning Lab	0	0	2	30	20	50	1
BT* UUU-18	Professional Elective Courses	Elective-II lab	0	0	2	30	20	50	1
BT* YYY-18	Professional Elective Courses	Elective-III lab	0	0	2	30	20	50	1
Total			**15**	**0**	**14**	**380**	**420**	**800**	**22**

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Seventh/ Eighth Semester

Course Code	Type of Course	Course Title	Hours per Week			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCS 601-18	Professional Core Courses	Compiler Design	3	0	0	40	60	100	3
BTAI ML70 1-20	Professional Core Courses	Computer Vision	3	0	0	40	60	100	3
BTOE ***	Open Elective Courses	Open Elective-II	3	0	0	40	60	100	3
BT* ZZZ-18	Professional Elective	Elective- IV	3	0	0	40	60	100	3
BT* TTT-18	Professional Elective Courses	Elective-V	3	0	0	40	60	100	3
BTCS 703-18	Project	Project-II	0	0	12	120	80	200	6
BT* ZZZ-18	Professional Elective	Elective- IV lab	0	0	2	30	20	50	1
BT* TTT-18	Professional Elective	Elective- V lab	0	0	2	30	20	50	1
Total			**15**	**0**	**16**	**380**	**420**	**800**	**23**

Seventh/Eighth Semester

Course Code	Course Title	Marks Distribution		Total Marks	Credits
		Internal	External		
BTCS 801-20	Semester Training	300	200	500	16

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LIST OF ELECTIVES

Elective I

BTAIML 505-20 Data Visualization using tableau
BTAIML 506-20 Data Visualization using tableau lab
BTAIML 507-20 User Interface development
BTAIML 508-20 User Interface development lab
BTAIML 509-20 Java Programming
BTAIML 510-20 Java Programming lab

Elective II

BTCS702-18	Data Mining and Data Warehouse
BTAIML609-20	Data Mining and Data Warehouse Lab
BTAIML601-20	Graph Theory
BTAIML602-20	Graph Theory Lab
BTDS603-20	Big Data Analytics
BTDS604-20	Big Data Analytics Lab

Elective III

BTAIML603-20	Neural Networks
BTAIML604-20	Neural Networks Lab
BTAIML605-20	Recommender System
BTAIML606-20	Recommender System Lab
BTAIML607-20	Advance Computing and Network Technologies
BTAIML608-20	Advance Computing and Network Technologies Lab

Elective IV

BTAIML703-20	NLP and Information Retrieval
BTAIML704-20	NLP and Information Retrieval Lab
BTAIML705-20	Network Security Applications using AI
BTAIML706-20	Network Security Applications using AI Lab
BTAIML707-20	Robotics and Intelligent systems
BTAIML708-20	Robotics and Intelligent systems Lab

Elective V

BTCS704-18	Deep Learning
BTCS705-18	Deep Learning Lab
BTAIML709-20	Applied Intelligence
BTAIML710-20	Applied Intelligenc lab
BTAIML711-20	Augmented and Virtual reality
BTAIML712-20	Augmented and Virtual Reality lab

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Third Semester

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Course Code: BTCS301-18	Course Title: Data Structure & Algorithms	3L:0T:P	3Credits

Detailed Contents:

Module 1: Introduction

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.

Searching: Linear Search and Binary Search Techniques and their complexity analysis.

[6 hrs] (CO1)

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

[10 hrs] (CO2, CO4, CO5)

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.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

[10 hrs] (CO2, CO4, CO5)

Module 4: Sorting and Hashing

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.

[10 hrs] (CO3)

Module 4: Graph

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

[6 hrs] (CO2, CO4)

Course Outcomes:

The student will be able to:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness;
2. Student will be able to handle operation like searching, insertion, deletion, traversing on various Data Structures and determine time and computational complexity;
3. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity;
4. Students will be able to choose appropriate Data Structure as applied to specific problem definition; &

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5. Demonstrate the reusability of Data Structures for implementing complex iterative problems.

Suggested Books:

1. "Classic Data Structures", Samanta and Debasis, 2nd edition, PHI publishers.
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.
3. "Data Structures with C (Schaum's Outline Series)", Seymour Lipschutz, 1st edition,McGraw Hill Education.

Reference Books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company.
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

Course Code: BTCS302-18	**Course Title:** Object Oriented Programming	**3L:0T:0P**	**3Credits**

Pre-requisites: Programming in C

Detailed Contents:

Module 1: Introduction

Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & function components, recursive functions, user - defined types, function overloading, inline functions, Classes & Objects – I: classes, Scope resolution operator, passing objects as arguments, returning objects, and object assignment.

[8 hrs] (CO1)

Module 2: Classes & Objects –FII

Constructors, Destructors, friend functions, Parameterized constructors, Static data members, Functions, Arrays of objects, Pointers to objects, this pointer, and reference parameter, Dynamic allocation of objects, Copyconstructors, Operator overloading using friend functions, overloading.

[8 hrs] (CO1, CO2)

Module 3: Inheritance

Base Class, Inheritance and protected members, Protected base class inheritance, Inheriting multiple base classes, Constructors, Destructors and Inheritance, Passing parameters to base class constructors, Granting access, Virtual base classes.

[8 hrs] (CO3, CO4)

Module 4: Virtual functions, Polymorphism

Virtual function, calling a Virtual function through a base class reference, Virtual attribute is inherited, Virtual functions are hierarchical, pure virtual functions, Abstract classes, Using virtual functions, Early and late binding.

[8 hrs] (CO3, CO4)

Module 5: Exception Handling

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Basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, I/O System Basics, File I/0: Exception handling fundamentals, Exception handling options. C++ stream classes, Formatted I/O, fstream and the File classes, Opening and closing a file, Reading and writing text files.

[10 hrs] (CO5)

Course Outcomes:

The student will be able to:

1. Identify classes, objects, members of a class and the relationships among them needed to solve a specific problem;
2. Demonstrate the concept of constructors and destructors. And create new definitions for some of the operators;
3. Create function templates, overload function templates;
4. Understand and demonstrate the concept of data encapsulation, inheritance, polymorphism with virtual functions; &
5. Demonstrate the concept of file operations, streams in C++ and various I/O manipulators.

Suggested Books:

1. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.

Reference Books:

1. Stanley B.Lippmann, JoseeLajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2011.

Course Code: BTCS303-18	**Course Title:** Data Structure & AlgorithmsLab	**0L:0T:4P**	**2Credits**

List of Experiment:

Task 1: Write a program to insert a new element at end as well as at a given position in an array.

Task 2: Write a program to delete an element from a given whose value is given or whose position is given.

Task 3: Write a program to find the location of a given element using Linear Search.

Task 4: Write a program to find the location of a given element using Binary Search.

Task 5: Write a program to implement push and pop operations on a stack using linear array.

Task 6: Write a program to convert an infix expression to a postfix expression using stacks.

Task 7: Write a program to evaluate a postfix expression using stacks.

Task 8: Write a recursive function for Tower of Hanoi problem.

Task 9: Write a program to implement insertion and deletion operations in a queue using linear array.

Task 10: Write a menu driven program to perform following insertion

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operations in a single linked list:

i. Insertion at beginning
ii. Insertion at end
iii. Insertion after a given node
iv. Traversing a linked list

Task 11: Write a menu driven program to perform following deletion operations in a single linked list:

i. Deletion at beginning
ii. Deletion at end
iii. Deletion after a given node

Task 12: Write a program to implement push and pop operations on a stack using linked list.

Task 13: Write a program to implement push and pop operations on a queue using linked list.

Task 14: Program to sort an array of integers in ascending order using bubble sort.

Task 15: Program to sort an array of integers in ascending order using selection sort.

Task 16: Program to sort an array of integers in ascending order using insertion sort.

Task 17: Program to sort an array of integers in ascending order using quick sort.

Task 18: Program to traverse a Binary search tree in Pre-order, In-order and Post-order.

Task 19: Program to traverse graphs using BFS.

Task 20: Program to traverse graphs using DFS.

Lab Outcomes:

The student will be able to:

1. Improve practical skills in designing and implementing basic linear data structure algorithms;
2. Improve practical skills in designing and implementing Non-linear data structure algorithms;
3. Use Linear and Non-Linear data structures to solve relevant problems;
4. Choose appropriate Data Structure as applied to specific problem definition; &
5. Implement Various searching algorithms and become familiar with their design methods.

Reference Books:

1. "Data Structures with C (Schaum's Outline Series)", Seymour Lipschutz, 1st edition,McGraw Hill Education.

Course Code: BTCS304-18	**Course Title:** Object Oriented Programming Lab	**0L:0T:4P**	**2Credits**

List of Experiment:

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Task 1: Write a program that uses a class where the member functions are defined inside a class.

Task 2: Write a program that uses a class where the member functions are defined outside a class.

Task 3: Write a program to demonstrate the use of static data members.

Task 4: Write a program to demonstrate the use of const data members.

Task 5: Write a program to demonstrate the use of zero argument and parameterized constructors.

Task 6: Write a program to demonstrate the use of dynamic constructor.

Task 7: Write a program to demonstrate the use of explicit constructor.

Task 8: Write a program to demonstrate the use of initializer list.

Task 9: Write a program to demonstrate the overloading of increment and decrement operators.

Task 10: Write a program to demonstrate the overloading of memory management operators.

Task 11: Write a program to demonstrate the typecasting of basic type to class type.

Task 12: Write a program to demonstrate the typecasting of class type to basic type.

Task 13: Write a program to demonstrate the typecasting of class type to class type.

Task 14: Write a program to demonstrate the multiple inheritances.

Task 15: Write a program to demonstrate the runtime polymorphism.

Task 16: Write a program to demonstrate the exception handling.

Task 17: Write a program to demonstrate the use of class template.

Task 18: Write a program to demonstrate the reading and writing of mixed type of data.

Lab Outcomes:

The student will be able to:

1. Develop classes incorporating object-oriented techniques;
2. Design and implement object-oriented concepts of inheritance and polymorphism;
3. Illustrate and implement STL class of containers and need for exceptions to handle errors for object oriented programs; &
4. Design and implement any real world based problem involving GUI interface using object-oriented concepts.

Reference Books:

1. Stanley B.Lippmann, JoseeLajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.

BTAM304-18	**Mathematics Paper-III (Calculus and Ordinary Differential Equations)**	**4L:1T:0P**	**4 credits**

Detailed Contents:

Module 1:

Limit, continuity for functions with severable variables, partial derivatives, total derivative, Maxima, minima and saddle points; Method of Lagrange multipliers, Multiple Integration: double and triple integrals (Cartesian and polar), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications of double and triple integrals to find surface area and volumes.
[CO1, CO2] **(12Hrs)**

Module 2:

Sequence and series, Bolzano Weirstrass Theorem, Cauchy convergence criterion for sequence, uniform convergence, convergence of positive term series: comparison test, limit comparison test, D'Alembert's ratio test, Raabe's test, Cauchy root test, p-test, Cauchy integral test, logarithmic test, Alternating series, Leibnitz test Power series, Taylor's series, Series for exponential, trigonometric and logarithmic functions. [CO3] **(13Hrs.)**

Module 3:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.
[CO4] **(12 hrs.)**

Module 4:

Second and higher order linear differential equations with constant coefficients, method of variation of parameters, Equations reducible to linear equations with constant coefficients: Cauchy and Legendre's equations. [CO5] **(12 hrs.)**

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

1. Understand the functions of several variables that are essential in mostbranches of engineering;
2. Apply multiple integrals to deal with areas and volumes of various structures which are quite significant in real world;
3. Formulate and solveengineering problems related to convergence, infinite series, power series and Taylor series;
4. Create, select and utilize the learnt techniques of first degree ordinary differential equationsto model real world problems &;
5. Be acquainted with the knowledge required to solve higher order ordinary differential equations.

Textbooks/References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
6. E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

Development of Societies
Course code: HSMC101-18

Credits: 3

COURSE TOPICS:

2.1 Unit I: Social Development (5 hours)

1. Concepts behind the origin of Family, Clan and Society
2. Different Social Systems
3. Relation between Human being and Society
4. Comparative studies on different models of Social Structures and their evolution

2.2 Unit II: Political Development (3 hours)

1. Ideas of Political Systems as learnt from History
2. Different models of Governing system and their comparative study

2.3 Unit III: Economic Development (18 hours)

1. Birth of Capitalism, Socialism, Marxism
2. Concept of development in pre-British, British and post British period- Barter, Jajmani
3. Idea of development in current context.
4. E. F. Schumacher's idea of development, Buddhist economics.

Gandhian idea of development. Swaraj and Decentralization.

3. READINGS

3.1 TEXTBOOK:

3.2 *REFERENCE BOOKS:

4. OTHER SESSIONS

4.1 *TUTORIALS:

4.2 *LABORATORY:

4.3 *PROJECT: Possible projects in this course could be

a) Interact with local communities and understand their issues.

b) Study local cottage industry and agricultural practices. Role of engineering and specialized knowledge.

c) Evaluation of technology in the context of its application. Social impact of technology. Environmental impact of technology. Evaluation from a holistic perspective.

PHILOSOPHY Course code: HSMC102-18

Credits: 3

COURSE TOPICS:

2.1 Unit 1:
The difference between knowledge (Vidya) and Ignorance (Avidya):
a. Upanishads;
b. Six systems orthodox and Heterodox Schools of Indian Philosophy.
c. Greek Philosophy:

2.2 Unit 2:
Origin of the Universe:

- NasidiyaSukta: "Who really knows?"
- Brhadaranyaka Upanishad; Chandogya Upanishad: Non-self, Self, real and unreal.
- Taittiriya Upanishad: SikshaValli.
- Plato's Symposium: Lack as the source of desire and knowledge.
- Socratic's method of knowledge as discovery.
- Language: Word as root of knowledge (Bhartrahari's Vakyapadiyam)
- Fourteen Knowledge basis as a sources of Vidya: Four Vedas; Six auxiliary sciences (Vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.

2.3 Unit 3:
Knowledge as Power: Francis Bacon. Knowledge as both power and self-realization in Bagavad Gita.

2.4 Unit 4:
Knowledge as oppression: M. Foucault. Discrimination between Rtam and Satyam in Indian Philosophy.

2.5 Unit 5:
Knowledge as invention: Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

2.6 Unit 6:
Knowledge about the self, transcendental self; knowledge about society, polity and nature.

2.7 Unit 7:
Knowledge about moral and ethics codes.

2.8 Unit 8:
Tools of acquiring knowledge: Tantrayuktis, a system of inquiry (Caraka, Sushruta, Kautilya, Vyasa)

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3. READINGS

1. Copleston, Frederick, History of Philosophy, Vol. 1.Great Britain: Continuum.
2 Hiriyanna, M. Outlines of Indian Philosophy, MotilalBanarsidass Publishers; Fifth Reprint edition (2009)
3 Sathaye, Avinash, Translation of NasadiyaSukta
4. Ralph T. H. Griffith. The Hymns of the Ṛgveda. MotilalBanarsidass: Delhi: 1973.
5. Raju, P. T. Structural Depths of Indian Thought, Albany: State University of New York Press.
6. Plato, Symposium, Hamilton Press.
7. KautilyaArtha Sastra. Penguin Books, New Delhi.
8. Bacon, Nova Orgum
9. Arnold, Edwin. The Song Celestial.
10. Foucault, Knowledge/Power.
11. Wildon, Anthony, System of Structure.
12. Lele, W.K. The Doctrine of Tantrayukti. Varanasi: Chowkamba Series.
13. Dasgupta, S. N. History of Indian Philosophy, MotilalBanasidas, Delhi.
14. Passmore, John, Hundred Years of Philosophy, Penguin.

4. OTHER SESSIONS:

4.1 Mode of Conduct

5. ASSESSMENT (indicative only):

Ask students to do term papers, for example, writing biographical details of founders, sustainers, transmitters, modifiers, rewriters; translating monographs of less known philosophers such as K. C. Bhattacharys, Daya Krishna, Gopinath Bhattacharya; comparative study of philosophical system such as MadhyasthaDarshan.

6. OUTCOME OF THE COURSE:

Students will develop strong natural familiarity with humanities along with right understanding enabling them to eliminate conflict and strife in the individual and society. Students shall be able to relate philosophy to literature, culture, society and lived experience can be considered.

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Course Code:BTES301-18	Course Title: Digital Electronics	3L:0T:0P	3Credits

Detailed Contents:

Module 1:

NUMBER SYSTEMS: Binary, Octal, Decimal, Hexadecimal. Number base conversions, 1's, 2's complements, signed Binary numbers. Binary Arithmetic, Binary codes: Weighted BCD, Gray code, Excess 3 code, ASCII.
LOGIC GATES: AND, OR, NOT, NAND, NOR, Exclusive-OR and Exclusive-NOR. Implementations of Logic Functions using gates, NAND-NOR implementations.

Module 2 :
BOOLEAN ALGEBRA: Boolean postulates and laws – De-Morgan's Theorem, Principle of Duality, Boolean expression – Boolean function, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS), Minterm, Maxterm, Canonical forms, Conversion between canonical forms, Karnaugh map Minimization, Don't care conditions, Quine-McCluskey method.

Module 3:
COMBINATIONAL CIRCUITS: Design procedure – Adders, Subtractors, BCD adder, Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker, code converters. Implementation of combinational logic using MUX, BCD to 7 segment decoder.

SEQUENTIAL CIRCUITS: Flip flops SR, JK, T, D and Master slave, Excitation table, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops. Asynchronous/Ripple counters, Synchronous counters, Modulo-n counter, Ring Counters. Design of Synchronous counters: state diagram, Circuit implementation. Shift registers.

Module 4:
MEMORY DEVICES: Classification of memories, RAM organization, Write operation, Read operation, Memory cycle. ROM organization, PROM, EPROM, EEPROM, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

A/D & D/A CONVERTORS : Analog & Digital signals. sample and hold circuit, A/D and D/A conversion techniques (Weighted type, R-2R Ladder type, Counter Type, Dual Slope type, Successive Approximation type).

COURSE OUTCOME:At the end of course the student will be able to:

1. Demonstrate the operation of simple digital gates, identify the symbols, develop the truth table for those gates; combine simple gates into more complex circuits; change binary, hexadecimal, octal numbers to their decimal equivalent an vice versa.
2. Demonstrate the operation of a flip-flop. Design counters and clear the concept of shift registers.
3. Study different types of memories and their applications.Convert digital signal into analog and vice versa.

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Suggested Readings/ Books:

- Morris Mano, **Digital Design**, Prentice Hall of India Pvt. Ltd
- Donald P.Leach and Albert Paul Malvino, **Digital Principles and Applications**, 5 ed., Tata McGraw HillPublishing CompanyLimited, New Delhi, 2003.
- R.P.Jain, **Modern Digital Electronics**, 3 ed., Tata McGraw–Hill publishing company limited, New Delhi, 2003.
- Thomas L. Floyd, **Digital Fundamentals**, Pearson Education, Inc, New Delhi, 2003
- Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, **Digital System - Principles and Applications**, PearsonEducation.
- Ghosal ,**Digital Electronics**, Cengage Learning.

Course Code:BTES302-18	Course Title: Digital Electronics Lab	0L:0T:2P	1Credits

List of Experiments:

1. To verify the Truth-tables of all logic gates.
2. To realize and verify the Half & full adder circuits using logic gates.
3. To realize Half & full subtractor circuits using logic gates.
4. To realize Encoder and Decoder circuits
5. To realize Multiplexer circuits
6. To realize 4-bit binary-gray & gray-binary converters.
7. To realize comparator circuit for two binary numbers of 2-bit each.
8. To realize Full adder & full subtractor circuits using encoder.
9. To design Full adder & full subtractor circuits using multiplexer.
10. To design and verify the Truth tables of all flip-flops.
11. To design Mod-6/Mod-9 synchronous up-down counter.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize combinational circuits using logic gates.
2. Realize sequential circuits using logic gates.
3. Realize various types of Flip-flops and counters

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Fourth Semester

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Course Code: BTES401-18 **Course Title:** Computer Organization & Architecture **3L:0T:0P** **3Credit**

Pre-requisites: Digital Electronics

Detailed Contents:

Module 1: Functional blocks of a computer

CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction set of 8085 processor.

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

[10 hrs] (CO1, CO2)

Module 2: Introduction to x86 architecture.

CPU control unit design: Hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes –role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

[12 hrs] (CO2, CO4)

Module 3: Pipelining

Basic concepts of pipelining, throughput and speedup, pipelin501e hazards.

Parallel Processors: Introduction to parallelprocessors, Concurrent access to memory and cache coherency.

[10 hrs] (CO5)

Module 4: Memory Organization

Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

[10 hrs] (CO3)

Course Outcomes:

The student will be able to:

1. Understand functional block diagram of microprocessor;
2. Apply instruction set for Writingassembly language programs;
3. Design a memory module and analyze its operation by interfacing with the CPU;
4. Classify hardwired and microprogrammed control units; &
5. Understand the concept of pipelining and its performance metrics.

Suggested Books:

1. "ComputerOrganization and Architecture", Moris Mano,
2. "ComputerOrganization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
3. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education.

Reference Books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Course Code: BTCS402-18	**Course Title:** Operating Systems	**3L:0T:0P**	**3Credits**

Detailed Contents:

Module 1: Introduction

Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

[6 hrs] (CO1)

Module 2: Processes

Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

[10 hrs] (CO2, CO3)

Module 3: Inter-process Communication

Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, StrictAlternation, Peterson's Solution, TheProducer\ConsumerProblem, Semaphores,EventCounters,Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

[8 hrs] (CO2)

Module 4: Deadlocks

Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

[8 hrs] (CO3)

Head

Module 5: MemoryManagement

Basicconcept,LogicalandPhysical address map, Memory allocation: Contiguous Memory allocation –Fixedandvariable partition–Internaland External fragmentation and Compaction; Paging: Principle of operation – Page allocation–Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

[10 hrs] (CO4)

Module 6: I/O Hardware
I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocationmethods (contiguous, linked, indexed), Free Space Management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

[8 hrs] (CO5, CO6)

Course Outcomes:
The student will be able to:
1. Explain basic operating system concepts such as overall architecture, system calls, user mode and kernel mode;
2. Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections;
3. Analyze and apply CPU scheduling algorithms, deadlock detection and prevention algorithms;
4. Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing;
5. Design and implement file management system; &
6. Appraise high-level operating systems concepts such as file systems, disk-scheduling algorithms and various file systems.

Suggested Books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Reference Books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Code: BTCS403-18	Course Title: Design and Analysis of Algorithms	3L:0T:0P	3Credits

Pre-requisites: Data Structures

Detailed Contents:

Module 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 Masters' theorem.

[8 hrs] (CO1)

Module 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, Knap Sack, TSP.

[10 hrs] (CO1, CO2)

Module 3: Graph and Tree Algorithms

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

[10 hrs] (CO3)

Module 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.

[8 hrs] (CO5)

Module 5: Advanced Topics

Approximation algorithms, Randomized algorithms, Heuristics and their characteristics.

[6 hrs] (CO1, CO4, CO5)

Course Outcomes:

The student will be able to:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms;
2. Explain when an algorithmic design situation calls for which design paradigm (greedy/ divide and conquer/backtrack etc.);
3. Explain model for a given engineering problem, using tree or graph, and writethe corresponding algorithm to solve the problems;
4. Demonstrate the ways to analyze approximation/randomized algorithms (expected running time, probability of error); &
5. Examine the necessity for NP class based problems and explain the use of heuristic techniques.

Suggested Books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Data Structures and Algorithms in C++, Weiss, 4th edition, Pearson.
3. Fundamentals of Computer Algorithms, E Horowitz, Sartaj Saini, Galgota Publications.

Reference Books

1. Algorithm Design, 1st Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Course Code: BTES402-18	Course Title: Computer Organization & ArchitectureLab	0L:0T:2P	1Credit

List of Experiment:

Task 1: Computer Anatomy- Memory, Ports, Motherboard and add-on cards.
Task 2: Dismantling and assembling PC.
Task 3: Introduction to 8085 kit.
Task 4: 2. Addition of two 8 bit numbers, sum 8 bit.
Task 5: Subtraction of two 8 bit numbers.
Task 6: Find 1's complement of 8-bit number.
Task 7: Find 2's complement of 8-bit number.
Task 8: Shift an 8-bit no. by one bit.
Task 9: Find Largest of two 8 bit numbers.
Task 10: Find Largest among an array of ten numbers (8 bit).
Task 11: Sum of series of 8 bit numbers.
Task 12: Introduction to 8086 kit.
Task 13: Addition and subtraction of two 16 bit numbers, sum 16 bit.
Task 14: Implement of Booth's algorithm for arithmetic operations.
Task 15: Find 1's and 2's complement of 16-bit number.
Task 16: Implement simple programs using I/O based interface.

Lab Outcomes:

The student will be able to:

1. Assemble personal computer;
2. Implement the various assembly language programs for basic arithmetic and logical operations; &
3. Demonstrate the functioning of microprocessor/microcontroller based systems with I/O interface.

Reference Books:

1. Fundamentals of Microprocessors and Microcontrollersby B. Ram, Dhanpat Rai Publications.

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Course Code: BTCS404-18	**Course Title:** Operating Systems Lab	**0L:0T:4P**	**2Credits**

List of Experiment:

Task 1: Installation Process of various operating systems.

Task 2: Implementation of CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority.

Task 3: Virtualization, Installation of Virtual Machine Software and installation of Operating System on Virtual Machine.

Task 4: Commands for files & directories: cd, ls, cp, md, rm, mkdir, rmdir. Creating and viewing files using cat. File comparisons. Disk related commands: checking disk free spaces. Processes in linux, connecting processes with pipes, background processing, managing multiple processes. Background process: changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep. Printing commands, grep, fgrep, find, sort, cal, banner, touch, file. File related commands ws, sat, cut, grep.

Task 5: Shell Programming: Basic of shell programming, various types of shell, Shell Programming in bash, conditional & looping statement, case statements, parameter passing and arguments, shell variables, shell keywords, creating shell programs for automate system tasks, report printing.

Task 6: Implementation of Bankers algorithm for the purpose of deadlock avoidance.

Lab Outcomes:

The student will be able to:

1. Understand and implement basic services and functionalities of the operating system;
2. Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority;
3. Implement commands for files and directories;
4. Understand and implement the concepts of shell programming;
5. Simulate file allocation and organization techniques; &
6. Understand the concepts of deadlock in operating systems and implement them in multiprogramming system.

Reference Books:

1. Operating Systems: Design and Implementation, Albert S. Woodhull and Andrew S. Tanenbaum, Pearson Education.

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Course Code: BTCS405-18	**Course Title:** Design and Analysis of Algorithms Lab	**0L:0T:4P**	**2Credit**

List of Experiment:

Task 1: Code and analyze solutions to following problem with given strategies:
- i. Knap Sack using greedy approach
- ii. Knap Sack using dynamic approach

Task 2: Code and analyze to find an optimal solution to matrix chain multiplication using dynamic programming.

Task 3: Code and analyze to find an optimal solution to TSP using dynamic programming.

Task 4: Implementing an application of DFS such as:
- i. to find the topological sort of a directed acyclic graph
- ii. to find a path from source to goal in a maze.

Task 5: Implement an application of BFS such as:
- i. to find connected components of an undirected graph
- ii. to check whether a given graph is bipartite.

Task 6: Code and analyze to find shortest paths in a graph with positive edge weights using Dijkstra's algorithm.

Task 7: Code and analyze to find shortest paths in a graph with arbitrary edge weights using Bellman-Ford algorithm.

Task 8: Code and analyze to find shortest paths in a graph with arbitrary edge weights using Flyods' algorithm.

Task 9: Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Prims' algorithm

Task 10: Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Kruskals' algorithm.

Task 11: Coding any real world problem or TSP algorithm using any heuristic technique.

Lab Outcomes:

The student will be able to:
1. Improve practical skills in designing and implementing complex problems with different techniques;
2. Understand comparative performance of strategies and hence choose appropriate, to apply to specific problem definition;
3. Implement Various tree and graph based algorithms and become familiar with their design methods; &
4. Design and Implement heuristics for real world problems.

Reference Books

1. Data Structures and Algorithms in C++, Weiss, 4th edition, Pearson
2. Data Structures and Algorithms using Python and C++, David M. Reed and John Zelle, 2009 edition (available as e book), Franklin Beedle& Associates.

UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Course code: HSMC122-18

Credits: 3

COURSE TOPICS:

The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and ExperientialValidation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensureSanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
17. Visualizing a universal harmonious order in society- Undivided Society,

Universal Order- from family to world family.
Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of peoplefriendly and eco -friendly production systems, c. Ability to identify and develop appropriatetechnologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems.
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

3. READINGS:

3.1 Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

3.2 Reference Books

1. Jeevan Vidya: EkParichaya, A. Nagaraj, Jeevan VidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.

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6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J CKumarappa
8. Bharat Mein Angreji Raj -PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

OUTCOME OF THE COURSE:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) Faculty -student or mentor-mentee programs throughout their time with the institution.

b) Higher level courses on human values in every aspect of living. E.g. as a professional.

Course Code: EVS101-18	Course Title: Environmental Studies-	L:2; T:0; P:0	0Credits

.Detailed Contents

Module 1 : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.
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Module 2 : Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.

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Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem

b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
-

Module 4 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rahabilitation of people; its problems and concerns.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust. Case Studies.
- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1(A) Awareness Activities:

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) Drive for segregation of waste
i) To live with some eminent environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
j) To know about the different varieties of plants
k) Shutting down the fans and ACs of the campus for an hour or so
l) Visit to a local area to document environmental assets river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

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m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H &Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

Course Code: HSMC101-18	Course Title: Development of Societies	3L:0T:0P	3Credits

Detailed Contents:

Unit I: Social Development (5 hours)

1. Concepts behind the origin of Family, Clan and Society
2. Different Social Systems
3. Relation between Human being and Society
4. Comparative studies on different models of Social Structures and their evolution

Unit II: Political Development (3 hours)

1. Ideas of Political Systems as learnt from History
2. Different models of Governing system and their comparative study

Unit III: Economic Development (18 hours)

1. Birth of Capitalism, Socialism, Marxism
2. Concept of development in pre-British, British and post British period- Barter, Jajmani
3. Idea of development in current context.
4. E. F. Schumacher's idea of development, Buddhist economics.

Gandhian idea of development. Swaraj and Decentralization.

PROJECT: Possible projects in this course could be

a) Interact with local communities and understand their issues.
b) Study local cottage industry and agricultural practices. Role of engineering and specialized knowledge.
c) Evaluation of technology in the context of its application. Social impact of technology. Environmental impact of technology. Evaluation from a holistic perspective.

Course Code: HSMC102-18	Course Title: PHILOSOPHY	3L:0T:0P	3Credits

Detailed Contents:

Unit 1:

The difference between knowledge (Vidya) and Ignorance (Avidya):

a. Upanishads;

b. Six systems orthodox and Heterodox Schools of Indian Philosophy.

c. Greek Philosophy:

Unit 2:

Origin of the Universe:

- NasidiyaSukta: "Who really knows?"
- Brhadaranyaka Upanishad; Chandogya Upanishad: Non-self, Self, real and unreal.
- Taittiriya Upanishad: SikshaValli.
- Plato's Symposium: Lack as the source of desire and knowledge.
- Socratic's method of knowledge as discovery.
- Language: Word as root of knowledge (Bhartrahari'sVakyapadiyam)
- Fourteen Knowledge basis as a sources of Vidya: Four Vedas; Six auxiliary sciences (Vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.

Unit 3:

Knowledge as Power: Francis Bacon. Knowledge as both power and self-realization in Bagavad Gita.

Unit 4:

Knowledge as oppression: M. Foucault. Discrimination between Rtam and Satyam in Indian Philosophy.

Unit 5:

Knowledge as invention: Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

Unit 6:

Knowledge about the self, transcendental self; knowledge about society, polity and nature.

Unit 7:

Knowledge about moral and ethics codes.

Unit 8:

Tools of acquiring knowledge: Tantrayuktis, a system of inquiry (Caraka, Sushruta, Kautilya, Vyasa)

READINGS

1. Copleston, Frederick, History of Philosophy, Vol. 1.Great Britain: Continuum.
2 Hiriyanna, M. Outlines of Indian Philosophy, MotilalBanarsidass Publishers; Fifth Reprint edition (2009)
3 Sathaye, Avinash, Translation of NasadiyaSukta
4. Ralph T. H. Griffith. The Hymns of the Ṛgveda. MotilalBanarsidass: Delhi: 1973.
5. Raju, P. T. Structural Depths of Indian Thought, Albany: State University of New York Press.
6. Plato, Symposium, Hamilton Press.
7. KautilyaArtha Sastra. Penguin Books, New Delhi.
8. Bacon, Nova Orgum
9. Arnold, Edwin. The Song Celestial.
10. Foucault, Knowledge/Power.
11. Wildon, Anthony, System of Structure.
12. Lele, W.K. The Doctrine of Tantrayukti. Varanasi: Chowkamba Series.
13. Dasgupta, S. N. History of Indian Philosophy, MotilalBanasidas, Delhi.

14. Passmore, John, Hundred Years of Philosophy, Penguin.

ASSESSMENT (indicative only):

Ask students to do term papers, for example, writing biographical details of founders, sustainers, transmitters, modifiers, rewriters; translating monographs of less known philosophers such as K. C. Bhattacharys, Daya Krishna, Gopinath Bhattacharya; comparative study of philosophical system such as MadhyasthaDarshan.

OUTCOME OF THE COURSE:

Students will develop strong natural familiarity with humanities along with right understanding enabling them to eliminate conflict and strife in the individual and society. Students shall be able to relate philosophy to literature, culture, society and lived experience can be considered.

BTCS401-18	**Discrete Mathematics**	**3L:1T:0P**	**4 Credits**

Detailed contents:

Module 1:

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic. CO1, CO2

Module 2:

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. CO3

Module 3:

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques:** Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. CO3, CO4

Module 4:

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form CO4

Module 5:

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes. Bi-connected component and Articulation Points, Shortest distances. CO5

Suggested books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

Suggested reference books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, TataMcgraw-Hill
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson,
3. Discrete Mathematics, Tata McGraw - Hill

Course Outcomes

1. To be able to express logical sentence in terms of predicates, quantifiers, and logical connectives
2. To derive the solution for a given problem using deductive logic and prove the solution based on logical inference
3. For a given a mathematical problem, classify its algebraic structure
4. To evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
5. To develop the given problem as graph networks and solve with techniques of graph theory.

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Fifth Semester

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Course Code: BTES 501-20	Course Title: Statistical Computing Techniques using R	3L:0T:0P	3 Credits

Course Contents:

UNIT 1: **CO1, CO2 [8 Hrs.]**

General introduction to computing, Using R as a calculator, Numbers, words and logicals; missing values (NA), Vectors and their attributes (names, length, type), System- and user-defined objects, Accessing data (data()). Data in the system and date outside the system (read.table, scan)

UNIT 2: **CO1, CO2 [10 Hrs.]**

First steps in graphics, The basics of R syntax, The R workspace. Matrices and lists, Subsetting System-defined functions; the help system, Errors and warnings, coherence of the workspace Data input and output; interface with other software packages, Writing your own code; R script Good programming practice, R syntax -- further steps The parentheses and brackets; =, == and <--

Apply-type functions Compiling and applying functions Documentation, Conditional statements Loops and iterations

UNIT 3: **CO1, CO2 [8 Hrs.]**

Exploratory data analysis, Range. summary, mean, variance, median, sd, histogram, box plot, scatterplot

Probability distributions, Random number generation Distributions, the practice of simulation.

UNIT 4: **CO1, CO2, CO3 [8 Hrs.]**

Statistical functions in R, Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models, advanced modelling methods, the bootstrap method to compute s.e.f

UNIT 5: **CO1, CO3 [8 Hrs.]**

Graphics; beyond the basics Graphics and tables, Working with larger datasets, Principles of exploratory data analysis (big data analysis)

Dataframes in R, Defining your own classes and operations Models and methods in R, Customising the user's environment

Reference Books:

1. Matloff, N. (2011). The Art of R Programming: A Tour of Statistical Software Design, William
2. Philip H. Pollock (2014). An R Companion to Political Analysis, CQ Press
3. Chihara, L. and Hesterberg, T. (2011), Mathematical statistics with resampling and R, Wiley
4. Lander, J. P. (2014) R for Everyone: Advanced Analytics and Graphics, Addison-Wesley Data & Analytics Series

Course Outcomes:

At the end of the course, students will have learned:

CO1: To use a fundamental tool for computing in the practice of quantitative analytical methods (the 'paper-and-pencil' tool of the 21st century), that can work for the small jobs (like a pocket calculator) as well as for the big jobs (complex statistical data analysis).

CO2: Programming, data handling, transformations, subsetting, exploratory data analysis, probability distributions and simulations, regression and linear models, summarising data, how to handle large data sets, effective graphics.

CO3: Modern concepts of statistics based on simulations and writing a report of a quantitative analysis.

Course Code: BTES 502-20	Course Title: Statistical Computing Techniques using R lab	0L:0T:2P	1 Credits

Details of Experiments

1. Familiarization of environments in R.
2. Perform simple arithmetic's using R.
3. Perform basic R functions.
4. Use various graphical techniques in EDA.
5. Create different charts for visualization of given set of data.
6. Find the mean, median, standard deviation and quartiles of a set of observations.
7. Find the Skewness and Kurtosis of a given dataset distribution.
8. Given the scenario, implement the Bayes rule by finding the posterior probability.
9. Find the mass function of a binomial distribution with n=20,p=0.4n=20,p=0.4. Also draw the graphs of the mass function and cumulative distribution function.
10. Generate and draw the cdf and pdf of a normal distribution with mean=10 and standard deviation=3. Use values of xx from 0 to 20 in intervals of 1.
11. Construct a scatter plot to investigate the relationship between two variables.
12. Perform the Z- test for single proportion, single mean etc.
13. Calculate the regression coefficient and obtain the lines of regression for the given data.
14. Compute confidence intervals for the mean when the standard deviation is known.
15. Perform F test
16. Perform Chi-Square test.

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Course Outcomes:

The Students will try to Learn:

CO1. Data manipulation, plot the graphs and charts with the help of computing features in R Programming.

CO2. The given data Interpretation with different distribution functions

CO3. The relevance and importance of the theory in solving practical problems in the real world

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Course Code: BTCS501-18	Course Title: Database Management Systems	3L:0T:0P	3Credits

Detailed Contents:

Module 1: Database system architecture

Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented Data models, integrity constraints, data manipulation operations.

[7hrs] (CO1,2)

Module 2: Relational query languages

Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

[10hrs] (CO2,4)

Module 3:

Storage strategies, Indices, B-trees, hashing.

[3hrs] (CO3)

Module 4: Transaction processing

Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

[6hrs] (CO3)

Module 5: Database Security

Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

[8hrs] (CO 4,5)

Module 6: Advanced Topics

Object oriented and object relational databases, Logical databases, Web databases, Distributed databases.

[8hrs] (CO 5)

Course Outcomes:

At the end of study, the student shall be able to:

CO1: write relational algebra expressions for a query and optimize the Developed expressions
CO2: design the databases using ER method and normalization.
CO3: construct the SQL queries for Open source and Commercial DBMS-MYSQL, ORACLE, and DB2.
CO4: determine the transaction atomicity, consistency, isolation, and durability.
CO5: Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Text Books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

Reference Books:

1. "Principles of Database and Knowledge–Base Systems", Vol1 by J. D. Ullman, Computer Science Press.
2. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education.
3. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley.

Course Code: BTCS505-18	**CourseTitle:** Database management System lab	**0L:0T:2P**	**1Credits**

List of Experiments:

Task 1: Introduction to SQL and installation of SQL Server / Oracle.

Task 2: Data Types, Creating Tables, Retrieval of Rows using Select Statement, Conditional Retrieval of Rows, Alter and Drop Statements.

Task 3: Working with Null Values, Matching a Pattern from a Table, Ordering the Result of a Query, Aggregate Functions, Grouping the Result of a Query, Update and Delete Statements.

Task 4: Set Operators, Nested Queries, Joins, Sequences.

Task 5: Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.

Task 6: PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.

Task 7: Stored Procedures and Exception Handling.

Task 8: Triggers and Cursor Management in PL/SQL.

Suggested Tools – MySQL, DB2, Oracle, SQL Server 2012, Postgre SQL, SQL lite•

Course Outcomes:

CO1: This practical will enable students to retrieve data from relational databases using SQL.

CO2: students will be able to implement generation of tables using datatypes

CO3: Students will be able to design and execute the various data manipulation queries.

CO4: Students will also learn to execute triggers, cursors, stored procedures etc.

Course Code: BTCS502-18	**Course Title:** Formal Language & Automata Theory	**3L:0T:0P**	**3Credits**

Detailed Contents

Module 1: Introduction

Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

[3hrs] (CO1)

Module 2: Regular languages and finite automata:

Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

[8hrs] (CO2)

Module 3: Context-free languages and pushdown automata

Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

[8hrs] (CO3)

Module 4: Context-sensitive languages

Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

[5hrs] (CO4)

Module 5: Turing machines

The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

[8hrs] (CO 5)

Module 6: Undecidability & Intractablity:

Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.
Intractablity: Notion of tractability/feasibility. The classes NP and co-NP, their importance. Polynomial time many-one reduction. Completeness under this reduction. Cook-Levin theorem: NP-completeness of propositional satisfiability, other variants of satisfiability. NP-complete problems from other domains: graphs (clique, vertex cover, independent sets, Hamiltonian cycle), number problem (partition), set cover

[12hrs] (CO5)

Course Outcomes: The student will be able to:

CO1: Write a formal notation for strings, languages and machines.

CO2: Design finite automata to accept a set of strings of a language.

CO3: Design context free grammars to generate strings of context free language.

CO4: Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars

CO5: Distinguish between computability and non-computability and Decidability and undecidability.

Text Books:

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

Reference Books:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.

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Course Code: BTAIML 502-20	Course Title : Artificial Intelligence	3L:0T:0P	3 Credits

Detailed Contents:

UNIT 1: Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents Basic Search Strategies: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

[8hrs] (CO 1)

UNIT 2: Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation, Minimax Search, Alpha-Beta Pruning Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem

[6hrs] (CO 2)

UNIT 3: Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Nonmonotonic Reasoning, Other Knowledge Representation Schemes, Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks

[6hrs] (CO 3)

UNIT 4: Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston's Learning Program, Decision Trees.

[6hrs]
(CO 4)

UNIT 5: Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, Knowledge Acquisition.

[6hrs] (CO 5)

Course Outcomes:

At the end of the course the student should be able to:

CO 1: Understand different types of AI agents.

CO 2: Develop different types of various AI search algorithms.

CO 3: Construct simple knowledge-based systems and to apply knowledge representation.

CO 4: Convert intermediate representation in contest to understand learning.

CO 5: Apply for various techniques for Expert Systems.

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Text Book:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, PrenticeHall, 2010.

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

Course Code: BTAIML504-20	**Course Title Artificial Intelligence Lab**	**L:0;T:0;P:2**	**1 Credits**

Detailed List of Tasks:

1. Write a programme to conduct uninformed and informed search.
2. Write a programme to conduct game search.
3. Write a programme to construct a Bayesian network from given data.
4. Write a programme to infer from the Bayesian network.
5. Write a programme to run value and policy iteration in a grid world.
6. Write a programme to do reinforcement learning in a grid world

Lab Outcomes: At the end of the course, the students are able to:

1. Explain artificial intelligence, its characteristics and its application areas.
2. Formulate real-world problems as state space problems, optimization problems or constraint satisfaction problems.
3. Select and apply appropriate algorithms and AI techniques to solve complex problems.
4. Design and develop an expert system by using appropriate tools and techniques.

Course Code: BTAIML501-20	**Course Title:** Programming in Python	**3L:0T:0P**	**3 Credits**	**42 Hours**

Detailed Contents:

Module 1:

Introduction to Python Programming Language: Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages.

Python Data Types & Input/Output: Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command.
Operators and Expressions: Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators.

[8hrs] (CO1)

Module 2:
Control Structures: Decision making statements, Python loops, Python control statements (break and continue), Asserts.
Python Native Data Types: Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods and operations).

[10hrs] (CO1, 3)

Module 3:
Python Functions: Functions, Advantages of Functions, Built-in Functions, User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables.
Python Modules: Module definition, Need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages.

[8hrs] (CO 1, 2,3)

Module 4:
Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python.
File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python.
Classes and Objects: The concept of OOPS in Python, Designing classes, Creating objects, Accessing attributes, Editing class attributes, Built-in class attributes, Garbage collection, Destroying objects. **[10hrs] (CO 2, 4)**

Module 5:
Generators and Iterators: Iterators, Generators, any and all functions, with statement, data compression.
Collections: namedtuple(), deque, ChainMap, Counter, OrderDict, DefaultDict, UserDict, UserList, UserString
Python Date and Time.

[6 hrs] (CO5)

Text Books:

1. Python programming: using problem solving approach, Reema Thareja, Oxford University Press.
2. Programming in Python, Pooja Sharma, BPB Publications.

<u>Course Outcomes:</u>

The students should be able to:

CO1: Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.

CO2: Demonstrate proficiency in handling Strings, Exceptions, and File Systems.

CO3: Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries.

CO4: Interpret the concepts of Object-Oriented Programming as used in Python.

CO5: Implement exemplary applications using date and time, generators, iterators, and collections in Python.

Course Code: BTAIML503-20	**Course Title:** Programming in Python Lab	**0L:0T:2P**	**1 Credits**

Prerequisites: Students should install Python.

<u>List of Experiments:</u>

Task 1: Write a program to demonstrate different number data types in Python.

Task 2: Write a program to perform different Arithmetic Operations on numbers in Python.

Task 3: Write a program to create, concatenate and print a string and accessing sub-string from a given string.

Task 4: Write a python script to print the current date in the following format "Sun May 29 02:26:23 IST 2017"

Task 5: Write a program to create, append, and remove lists in python.

Task 6: Write a program to demonstrate working with tuples in python.

Task 7: Write a program to demonstrate working with dictionaries in python.

Task 8: Write a python program to find largest of three numbers.

Task 9: Write a Python program to convert temperatures to and from Celsius, Fahrenheit. [Formula: c/5 = f-32/9]

Task 10: Write a Python program to construct the following pattern, using a nested for loop *

```
*
* *
* * *
* * * *
* * *
* *
*
*
```

Task 11: Write a Python script that prints prime numbers less than 20.

Task 12: Write a python program to find factorial of a number using Recursion.

Task 13: Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides).

Task 14: Write a python program to define a module to find Fibonacci Numbers and import the module to another program.

Task 15: Write a python program to define a module and import a specific function in that module to another program.

Task 16: Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.

Task 17: Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

Task 18: Write a Python class to convert an integer to a roman numeral.

Task 19: Write a Python class to implement pow(x, n)

Task 20: Write a Python class to reverse a string word by word.

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ELECTIVE-I

BTAIML 505-20	Data Visualization Using Tableau	3L:0T:0P	3 Credits

Course Objectives:

Students should be able to describe and implement various:-

1. To understand the tableau terminologies and its fields.
2. To explain the methodologies to create a chart.
3. To gain knowledge about the different Chart types in tableau.
4. To get used with chart types and frameworks.

Detailed contents:

UNIT 1 INTRODUCTION TO DATA VISUALIZATION AND TABLEAU:

Acquiring and Visualizing Data, Applications of Data Visualization, Key Factors of Data Visualization. Introduction to Tableau Connecting to Data in Tableau, Shaping Data for Use with Tableau, Tableau Terminology. Views of data and records, Measure, Dimension, Discrete and Continuous.

(9 hrs., CO1)

UNIT 2 CREATION OF CHARTS IN TABLEAU:

Creation of bar charts in Tableau, Aggregation, Line Graphs, Independent Axes, Date Hierarchies, Marks Cards, Encoding, Level of Detail, Filters, Calculated fields, Table Calculations: - Parameters, Level of detail expressions, Dashboards and distribution.

(10 hrs, CO2)

UNIT 3 CHART TYPES:

Spreadsheet – Highlight table, Heat Map, Dual-Axis Combination Chart, Scatter Plot, Tree Map, Spark lines, Small Multiples, Bullet graphs, Stacked area, Histogram, Box and Whisker Plot, Symbol Map, Mapbox , Filled Map , Dual axis Map, Sequential Map , Polygon Maps, Gant Chart , Waterfall Chart, Dual, Axis Slope Graphs , Donut Chart , Funnel Chart, Pace chart ,Pareto Chart , Control Chart , Dynamic Dual-Axis Bump Chart ,dumbbell Chart .

(10 hrs, CO3)

UNIT 4 DATA CONNECTIVITY, TRENDS AND FORECASTING:

Data Joins, updates, exits, updating charts, Icon-Based Navigation, Filters – Analysis using Parameters , Adding alerts to dashboards, Methodology Using Custom Shape Palettes , Tableau

Data Visualization Tips, Alternative Approaches to Pie Charts ,One-Dimensional Unit Charts , Insight Framework for Data Visualization , Steps in Insight Framework – Introduction to Data Storytelling and its elements . Trends and Forecasting – Create trend lines – Model types – Create forecast.

(13 hrs, CO4,5)

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

CO1 Infer the representation of tableau and its fields.

CO2 Explore charts that are present in tableau.

CO3 Apply the various charts used for data visualization

CO4 Apply visualization tips in charts

CO5 Learn to connect the Database to tableau and forecast the predictions.

Text Books:

1 Ryan Sleeper," Practical Tableau" O'Reilly Media, Inc, First Edition, 2018
2 Learning Tableau 2020: Create effective data visualizations, build interactive visual analytics, and transform your organization, 4th Edition, 2020

Extensive Reading:

1. https://www.datacamp.com/courses/introduction–to–data–visualization–with–python
2. https://machinelearningmastery.com/data–visualization–methods–in–python.
3. https://www.kaggle.com/benhamner/python–data–visualization

BTAIML 505-20	Data Visualization Using Tableau Lab	0L:0T:2P	1 Credits

Laboratory Work as given in the theory curriculum as guided by the instructor.

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BTAIML 509-20	Java Programming	3L:0T:0P	3.Credits

Detailed contents:

UNIT 1:

The Java Environment: Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions.

Basic Language Elements: Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.

5 hrs., CO1, CO5

UNIT 2:

Object Oriented Programming: Class Fundamentals, Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects, Constructor & initialization code block, Access Control, Modifiers, methods Nested, Inner Class &Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, dealing with Static Members, Finalize() Method, Native Method. Use of "this "reference, Use of Modifiers with Classes & Methods, Design of Accessors and Mutator Methods Cloning Objects, shallow and deep cloning, Generic Class Types.

Extending Classes and Inheritance: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of "super", Polymorphism in inheritance. Type Compatibility and Conversion Implementing interfaces.

10 hrs., CO2, CO5

UNIT 3:

Package: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention for Packages.

Exception Handling: The Idea behind Exception, Exceptions & Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions, Checked and Un-Checked Exceptions.

Array & String: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Using Collection Bases Loop for String, Tokenizing a String, Creating Strings using StringBuffer.

Thread: Understanding Threads, Needs of Multi-Threaded Programming, Thread Life-Cycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads. Critical Factor in Thread –DeadLock, 10 hrs., CO3, CO5

UNIT 4:

GUI Programming: Designing Graphical User Interfaces in Java. Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework : Collections of Objects , Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of ArrayList & Vector.

10 hrs., CO4, CO5

UNIT 5:

Database Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture, CURD operation Using JDBC, Connecting to non-conventional Databases.

Java Server Technologies Servlet: Web Application Basics, Architecture and challenges of Web Application, Introduction to servlet, Servlet life cycle, Developing and Deploying Servlets, Exploring Deployment , Descriptor (web.xml), Handling Request and Response.

8 hrs., CO4, CO5

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

CO1: Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism

CO2. Design and develop java programs, analyze, and interpret object oriented data and report results.

CO3. Design an object oriented system, AWT components and multithreaded processes as per needs and specifications.

CO4: Understand the database connectivity and design web based applications on client server model

CO5. Participate and succeed in competitive examinations like GATE, Engineering services, recruitment interviews etc.

REFERENCES:

Text Books:

1. The Complete Reference Java, Herbert Schildt, ISBN: 978-0-07 163177-8, Publisher: McGraw Hill, 7th Edi.

2. Thinking in Java, Bruce Eckel, ISBN: 0-13-187248-6, Publisher: Prentice Hall 4th Edition

3. The Java Programming Languages,, Ken Arnold, ISBN-13: 978- 032134980, Publisher: Sun 4th Edition,

4. Java in Nutshell,, Benjamin,ISBN: 9781449371296, Publisher: O'Reilly Media, Inc. 6th Edi.

BTAIML 510-20	Java Programming Lab	0L:0T:2P	1 Credits

LIST OF EXPERIMENTS:

1. Write a Java program that implements Quick sort algorithm for sorting a list of names in ascending order

2. . Write a Java program that implements Bubble sort algorithm for sorting in descending order and also shows the number of interchanges occurred for the given set of integers.

3. Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that Integer?

4. Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome?

5. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divided by zero.

6. Write a Java program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num 2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the exception in a message dialog box.

7. Write a Java program for the following: Create a doubly linked list of elements. Delete a given element from the above list. Display the contents of the list after deletion.

8. a) Develop an applet in Java that displays a simple message.

b) Develop an applet in Java that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named "Compute" is clicked.

9. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.

10. Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas. Write a java program to display the table using Labels in Grid Layout.

11. Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired (Use Adapter classes).

12 Write a Java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

13. Write a Java program that correctly implements the producer – consumer problem using the concept of interthread communication.

REFERENCE BOOKS

1. Java for Programmers, P. J. Deitel and H. M. Deitel, 10th Edition Pearson education.

2. Thinking in Java, Bruce Eckel, Pearson Education.

3. Java Programming, D. S. Malik and P. S. Nair, Cengage Learning.

4. Core Java, Volume 1, 9th edition, Cay S. Horstmann and G Cornell, Pearson.

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

CO1: Use Java compiler and eclipse platform to write and execute java program.

CO2: Understand and Apply Object oriented features and Java concepts.

CO3: Apply the concept of multithreading and implement exception handling.

CO4: Access data from a Database with java program.

CO5: Develop applications using Console I/O and File I/O,GUI applications

Note:

1. Use LINUX and MySQL for the Lab Experiments. Though not mandatory, encourage the use of Eclipse platform.

2. The list suggests the minimum program set. Hence, the concerned staff is requested to add more problems to the list as needed.

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Course Code: BTAIML507-20	Course Title: User Interface development	3L:0T:0P	3 Credits	42 Hours

Detailed Contents:

UNIT 1:

The User Interface: Introduction & Overview, The importance of user interface – Defining the user interface, The importance of Good design, Characteristics of graphical and web user interfaces, Principles of user interface design. (8L)

UNIT 2:

The User Interface Design process: Obstacles, Usability, Human characteristics in Design, Human Interaction speeds, Business functions-Business definition and requirement analysis, Basic business functions, Design standards. (8L)

UNIT 3:

System menus and navigation schemes : Structures of menus, Functions of menus, Contents of menus, Formatting of menus Phrasing the menu, Selecting menu choices, Navigating menus, Kinds of graphical menus (8L)

UNIT 4:

Windows: Characteristics, Components of window, Window presentation styles, Types of window, Window management, Organizing window functions, Window operations, Web systems, Characteristics of device based controls. (8L)

UNIT 5:

Screen based controls: Operable control, Text control, Selection control, Custom control, Presentation control, Windows Tests-prototypes, kinds of tests. (8L)

Text Book:

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002.

Reference Books:

1. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.

2. Alan Cooper, "The Essential of User Interface Design", Wiley- Dream Tech Ltd.,2002

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Course Code: BTAIML508-20	Course Title: user interface development Lab	0L:0T:2P	1 Credits

Design and Development of User Interfaces using HTML, CSS, JavaScript and Angular JS / Node JS technologies

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Sixth Semester

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Course Code: BTCS 504-18	**Course Title:** Computer Networks	**3L:0T:0P**	**3 Credits**

Detailed Contents:

Module 1: Data Communication Components

Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

[8hrs] (CO1)

Module 2: Data Link Layer and Medium Access Sub Layer

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CDCDMA/CA.

[10 hrs] (CO2)

Module 3: Network Layer

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

[8 hrs] (CO3)

Module 4: Transport Layer

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

[8 hrs] (CO3)

Module 5: Application Layer

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

[8 hrs] (CO4)

Course Outcomes: The student will be able to:

CO1: Explain the functions of the different layer of the OSI Protocol;

CO2:. Describe the function of each block of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs);

CO3: Develop the network programming for a given problem related TCP/IP protocol; &

CO4: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Reference Books:

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

Course Code: BTCS 619-18	**Course Title:** Machine Learning	**3L:0T:0P**	**3 Credits**

Detailed Contents:

UNIT 1: **Introduction:** Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning and Reinforcement learning.

[4hrs] (CO 1)

UNIT 2: Data Pre-processing: Need of Data Pre-processing, Data Pre-processing Methods: Data Cleaning, Data Integration, Data Transformation, Data Reduction; Feature Scaling (Normalization and Standardization), Splitting dataset into Training and Testing set.

[4hrs] (CO 2)

UNIT 3: Regression: Need and Applications of Regression, Simple Linear Regression, Multiple Linear Regression and Polynomial Regression, Evaluating Regression Models Performance (RMSE, Mean Absolute Error, Correlation, RSquare, Accuracy with acceptable error, scatter plot, *etc.*)

[6hrs] (CO 3)

UNIT 4 Classification: Need and Applications of Classification, Logistic Regression, Decision tree, Tree induction algorithm – split algorithm based on information theory, split algorithm based on Gini index; Random forest classification, Naïve Bayes algorithm; K-Nearest Neighbours (K-NN), Support Vector Machine (SVM), Evaluating Classification Models Performance (Sensitivity, Specificity, Precision, Recall, *etc.*). **Clustering**: Need and Applications of Clustering, Partitioned methods, Hierarchical methods, Density-based methods.

[12hrs] (CO 4)

UNIT 5 Association Rules Learning: Need and Application of Association Rules Learning, Basic concepts of Association Rule Mining, Naïve algorithm, Apriori algorithm. **Artificial Neural Network:** Need and Application of Artificial Neural Network, Neural network representation and working, Activation Functions.

Genetic Algorithms: Basic concepts, Gene Representation and Fitness Function, Selection, Recombination, Mutation and Elitism.

[14hrs] (CO 5)

Course Outcomes:

After undergoing this course, the students will be able to:

CO1: Analyse methods and theories in the field of machine learning

CO2: Analyse and extract features of complex datasets

CO3: Deploy techniques to comment for the Regression

CO4: Comprehend and apply different classification and clustering techniques

CO5: Understand the concept of Neural Networks and Genetic Algorithm

Suggested Readings/ Books:

Text Books:

1. Mitchell M., T., Machine Learning, McGraw Hill (1997) 1stEdition.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2014) 3rdEdition.
3. Vijayvargia Abhishek, Machine Learning with Python, BPB Publication (2018)

Reference Books:

1. Bishop M., C., Pattern Recognition and Machine Learning, Springer-Verlag (2011) 2ndEdition.
2. Michie D., Spiegelhalter J. D., Taylor C. C., Campbell, J., Machine Learning, Neural and Statistical Classification. Overseas Press (1994).

Course Code: BTCS 507-18	**Course Title:** Computer Networks Lab	**0L:0T:2P**	**1 Credits**

List of Experiments:

Task 1: To study the different types of Network cables and network topologies.

Task 2: Practically implement and test the cross-wired cable and straight through cable using clamping tool and network lab cable tester.

Task 3: Study and familiarization with various network devices.

Task 4: Familiarization with Packet Tracer Simulation tool/any other related tool.

Task 5: Study and Implementation of IP Addressing Schemes

Task 6: Creation of Simple Networking topologies using hubs and switches

Task 7: Simulation of web traffic in Packet Tracer

Task 8: Study and implementation of various router configuration commands

Task 9: Creation of Networks using routers.

Task 10: Configuring networks using the concept of subnetting

Task 11: Practical implementation of basic network command and Network configuration commands like ping, ipconfig, netstat, tracert etc. for troubleshooting network related problems.

Task 12: Configuration of networks using static and default routes.

Course Outcomes:

The students will be able to:

CO1: Know about the various networking devices, tools and also understand the implementation of network topologies;

CO2: Create various networking cables and know how to test these cables;

CO3: Create and configure networks in packet trace rtool using various network devices and topologies;

CO4: Understand IP addressing and configure networks using the subnet in;

CO5: Configure routers using various router configuration commands.

Suggested Tools - **NS2/3, Cisco packet tracer, Netsim etc.**.

Course Code: BTCS620-18	Course Title: Machine Learning Lab	L:0;T:0;2 P:1Credits

Detailed List of Tasks:

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1. Implement data pre-processing
2. Deploy Simple Linear Regression
3. Simulate Multiple Linear Regression
4. Implement Decision Tree
5. Deploy Random forest classification
6. Simulate Naïve Bayes algorithm
7. Implement K-Nearest Neighbors (K-NN), k-Means
8. Deploy Support Vector Machine, Apriori algorithm
9. Simulate Artificial Neural Network
10. Implement the Genetic Algorithm code

Suggested Tools Python/R/MATLAB

ELECTIVE –II

Course Code: BTCS 702-18	Course Title: Data Mining and Data Warehousing	3L: 0T: 0P	Credits: 3

Detailed Contents:

UNIT 1:

Data Warehousing Introduction: design guidelines for data warehouse implementation, Multidimensional Models; OLAP- introduction, Characteristics, Architecture, Multidimensional view Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP and data cube, Data cube operations, data cube computation.

Data mining: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity **[10hrs]**

UNIT 2:

Data mining: Introduction, association rules mining, Naive algorithm, Apriori algorithm, direct hashing and pruning (DHP), Dynamic Item set counting (DIC), Mining frequent pattern without candidate generation (FP, growth), performance evaluation of algorithms

Classification: Introduction, decision tree, tree induction algorithms – split algorithm based on information theory, split algorithm based on Gini index; naïve Bayes method; estimating predictive accuracy of classification method

[10 hrs]

UNIT 3:

Cluster analysis: Introduction, partition methods, hierarchical methods, density based methods, dealing with large databases, cluster software

Search engines: Characteristics of Search engines, Search Engine Functionality, Search Engine Architecture, Ranking of web pages, The search engine history, Enterprise Search, Enterprise Search Engine Software. **[10 hrs]**

UNIT 4:

Web data mining: Web Terminology and Characteristics, Locality and Hierarchy in the web, Web Content Mining, Web Usage Mining, Web Structure Mining, Web mining Software. **[8 hrs]**

Suggested Readings / Books:

1. Carlo Vercellis, Business Intelligence: Data mining and Optimization for Decision Making, WILEY.

2. Han J., Kamber M. and Pei J. , b Data mining concepts and techniques, Morgan Kaufmann Publishers (2011) 3rd ed.

3. Pudi V., Krishana P.R., Data Mining, Oxford University press, (2009) 1st ed.

4. Adriaans P., Zantinge D., Data mining, Pearsoneducation press (1996), 1st ed.

5. Pooniah P. , Data Warehousing Fundamentals, Willey interscience Publication, (2001), 1st ed.

Course Code: BTAIML609-20	Course Title: Data Mining and Data Warehousing lab	0L: 0T: 2P

List of Experiments:

Task 1: Build Data Warehouse and Explore WEKA

Task 2: Perform data preprocessing tasks and demonstrate performing association rule mining on data sets

Task 3: Demonstrate performing classification on data sets

Task 4: Demonstrate performing clustering on data sets

Task 5: Demonstrate performing Regression on data sets

Task 6: Create Credit Risk Assessment Sample Programs using suitable Credit Data set

Task 7: Create Sample Programs using Hospital Management System

Task 8: Beyond the Syllabus -Simple Project on Data Preprocessing

COURSE OUTCOMES: The students will be able to:

1. Understand the various kinds of tools.
2. Demonstrate the classification, clustering and etc. in large data sets.
3. Ability to add mining algorithms as a component to the exiting tools.
4. Ability to apply mining techniques for realistic data.

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Course Code: BTAIML601-20	Course Title: Graph Theory	3L:0T:0P	3Credits

Detailed Contents:

Module 1: Introduction

Introduction-Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.

[10 hrs] (CO1)

Module 2:

Connected graphs and shortest paths - Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm. •

[8 hrs] (CO1, CO2)

Module 3:

Trees- Definitions and characterizations, Number of trees, Cayley's formula, Kircho-matrix-tree theorem, Minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury's algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.. [8 hrs] (CO3)

Module 4:

Independent sets coverings and matchings– Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall's Theorem, K¨onig's Theorem, Perfect matchings in graphs, Greedy and approximation algorithms. [8 hrs] (CO3, CO4)

Module 5:

Vertex Colorings- Basic definitions, Cliques and chromatic number, Mycielski's theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1 and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring. [10 hrs] (CO4)

Course Outcomes:

The student will be able to:

1.Know some important classes of graph theoretic problems.

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2.Be able to formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs.

3.Be able to describe and apply some basic algorithms for graphs.

4.Be able to use graph theory as a modelling tool.

Suggested Books:

1. J. A. Bondy and U. S. R. Murty. Graph Theory, volume 244 of Graduate Texts in Mathematics. Springer, 1st edition, 2008.

2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.

Reference Books:

1. Lecture Videos: http://nptel.ac.in/courses/111106050/13

2. Introduction to Graph Theory, Douglas B. West, Pearson .

3 Schaum's Outlines Graph Theory, Balakrishnan, TMH

4. Introduction to Graph Theory, Wilson Robin j, PHI

5. Graph Theory with Applications to Engineering And Computer Science, Narsing Deo, PHI

6. Graphs - An Introductory Approach, Wilson and Watkin

Course Code: BTAIML602-20	**Course Title:** Graph Theory Lab	0L:0T:2P	1Credits

List of Experiment:

Task 1: Write a program to find the number of vertices, even vertices, odd vertices and number of edges in a Graph.

Task 2: Write a program to Find Union, Intersection and ring-sum of 2 graphs.

Task 3: Write a program to Find Minimum Spanning tree Using Prim's Algorithm.

Task 4: Write a program to Find Minimum Spanning tree Using Kruskal's Algorithm.

Task 5: Write a program to find Shortest Path between 2 Vertices using Dijkstra Algorithm.

Task 6: Write a program to find Shortest Path between every pair of vertices in a graph using Floyd-Warshall's Algorithm.

Task 7: Write a program to find Shortest Path between 2 Vertices using Bellman Ford's Algorithm.

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Task 8: Write a program for finding maximum Matching for bipartite graph

Task 9: Write a program for finding maximum Matching for General Path

Task 10: Write a program to find maximum flow from source node to sink node using Ford-Fulkerson Algorithm

Lab Outcomes:

The student will be able to:

1. Develop classes incorporating object-oriented techniques;

2. Design and implement object-oriented concepts of inheritance and polymorphism;

3. Illustrate and implement STL class of containers and need for exceptions to handle errors for object oriented programs; &

4. Design and implement any real world based problem involving GUI interface using object-oriented concepts.

Reference Books:

1. Lecture Videos: http://nptel.ac.in/courses/111106050/13.
2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.

Course Code: BTDS 603-20	Course Title: Big Data Analytics	L:3 T:0 P:0	3 Credits

Detailed Contents:

Module I

Introduction: Big Data Overview, The rising and importance of data sciences, Big data analytics in industry verticals CO1

Hadoop Architecture: Hadoop Architecture, Hadoop ecosystem components, Hadoop Storage: HDFS, Hadoop Processing: MapReduce Framework, Hadoop Server Roles CO2

Module II

Data Analytics Lifecycle and methodology: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Communicating results, Deployment, Data exploration & preprocessing CO2

Module III

Data Analytics - Theory & Methods: Measures and evaluation, Supervised learning, Linear/Logistic regression, o Decision trees, Naïve Bayes, Unsupervised learning, K-means clustering, Association rules, Unstructured Data Analytics, Technologies & tools, Text mining, Web mining CO3

Module IV

The Endgame: Opertionalizing an Analytics project, Data Visualization Techniques, Creating final deliverables CO4

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Course Outcomes

1. Describe Big Data and its importance with its applications

2. Differentiate various big data technologies like Hadoop MapReduce, Pig, Hive, Hbase and No-SQL.

3. Apply tools and techniques to analyze Big Data.

4. Design a solution for a given problem using suitable Big Data Techniques

Text Books:

1. Hadoop: The Definitive Guide by Tom White

2. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph by David Loshin

3. Machine Learning by Tom M. Mitchell

Course Code: BTDS 604-20	**Course Title: Big Data Analytics Lab**	**L:0 T:0 P:2**	**1 Credits**

List of Experiments:

1. Hands-on with Map Reduce: Hadoop, Hive, MapR
2. Hands-on with NoSQL Databases: S3, Hadoop Distributed File System(HDFS)
3. Hands-on with Statistical Packages
4. Hands-on with Visual Data Analysis tools

Lab Outcomes:

CO1: Perform data gathering of large data from a range of data sources.
CO2: Critically analyse existing Big Data datasets and implementations, taking practicality, and usefulness metrics into consideration.
CO3: Select and apply suitable statistical measures and analyses techniques for data of various structure and content and present summary statistics
CO4: Employ advanced statistical analytical skills to test assumptions, and to generate and present new information and insights from large datasets

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ELECTIVE-III

Course Code: BTAIML 603-20	Course Title: Neural Networks	3L:0 T: 0P	Credits: 3

Detailed Contents:

UNIT 1 Introduction **7 hours CO1**

What is a Neural Network?, Human Brain, Models of Neuron, Neural Networks viewed as directed graphs, Feedback, Network Architectures, Knowledge representation, Artificial Intelligence and Neural Networks.

UNIT 2 Learning Processes – 1 **6 hours CO1,3**

Introduction, Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzamann learning, Credit Assignment problem, Learning with a Teacher, Learning without a Teacher, Learning tasks, Memory, Adaptation.

Learning Processes – 2, Single Layer Perceptrons **7 hours CO3**

Statistical nature of the learning process, Statistical learning theory, Approximately correct model of learning. Single Layer Perceptrons: Introduction, Adaptive filtering problem, Unconstrained optimization techniques, Linear least-squares filters, Least-mean square algorithm, Learning curves, Learning rate annealing techniques,Perceptron, Perceptron convergence theorem, Relation between the Perceptron and Bayes classifier for a Gaussian environment.

UINT3 Multilayer Perceptrons – 1 **6 hours CO2**

Introduction, Some preliminaries, Back-propagation Algorithm, Summary of back-propagation algorithm, XOR problem, Heuristics for making the back-propagation algorithm perform better, Output representation and decision rule, Computer experiment, Feature detection, Back-propagation and differentiation.

Multilayer Perceptrons – 2 **7 hours CO2**

Hessian matrix, Generalization, approximation of functions, Cross validation, Network pruning techniques, virtues and limitations of back- propagation learning, Accelerated convergence of back propagation learning, Supervised learning viewed as an optimization problem, Convolution networks.

UNIT4 Radial-Basic Function Networks – 1 **6 hours CO2**

Introduction, Cover's theorem on the separability of patterns, Interpolation problem, Supervised learning as an ill-posed Hypersurface reconstruction problem, Regularization theory, Regularization networks, Generalized radial-basis function networks, XOR problem, Estimation of the regularization parameter.

Radial-Basic Function Networks – 2 **6 hours CO2,4**

Approximation properties of RBF networks, Comparison of RBF networks and multilayer Perceptrons, Kernel regression and it's relation to RBF networks, Learning strategies, Computer experiment. Optimization using Hopfield networks: Traveling salesperson problem, Solving simultaneous linear equations, Allocating documents to multiprocessors.

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

CO1 Understand the learning and generalisation issue in neural computation.

CO2 Understand the basic ideas behind most common learning algorithms for multilayer perceptrons, radial-basis function networks, and Kohonen self-organising maps.

CO3 Implement common learning algorithms using an existing package.

CO4 Apply neural networks to classification and recognition problems.

Text Books:

1	The Essence of Neural Networks	R. Callan	Prentice Hall Europe, 1999
2.	Neural Networks: A Comprehensive Foundation		Simon Haykin Prentice Hall, 1999.
3.	Neural Networks and learning Machine		Haykin, Pearson, 2005, 3rd ed.

Course Code: BTAIML 604-20	**Course Title: Neural Networks lab**	**0L:0 T: 2P**	**Credits: 1**

List of experiments

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1. Write a program to perform the basics matrix operations.
2. WAP to plot the Straight line.
3. WAP to plot the Sine curve.
4. How the weight & bias value effects the output of neurons.
5. How the choice of activation function effect the output of neuron experiment with the

following function purelin(n), bimary threshold(hardlim(n) haradlims(n)) ,Tansig(n) logsig(n)

6. How the weight and biased value are able to represent a decision boundary in the feature space.
7. How the Perceptron Learning rule works for Linearly Separable Problem.
8. How the Perceptron Learning rule works for Non-Linearly Separable Problem.
9. Write a program to draw a graph with multiple curve.

Experiments can be performed in MATLAB/ Python

Course Code: BTAIML605-20	**Course Title:** Recommender System	3L:0T:0P	3Credits

Detailed Contents:

Module 1: Introduction

Introduction and basic taxonomy of recommender systems (RSs). Traditional and non-personalized RSs. Overview of data mining methods for recommender systems (similarity measures, classification, Bayes classifiers, censembles of classifiers, lustering, SVMs, dimensionality reduction). Overview of convex and linear optimization principles

[3 hrs] (CO1)

Module 2: Content-based recommender systems

The long-tail principle. Domain-specific challenges in recommender systems. Content-based recommender systems. Advantages and drawbacks. Basic component's of content-based RSs. Feature selection. Item representation Methods for learning user profiles

[3 hrs] (CO1, CO2)

Module 3: Collaborative Filtering (CF)-based RSs

Mathematical optimization in CF RSs. Optimization objective. Baseline predictor through least squares. Regularization and overfitting. Temporal models. Step-by-step solution of the RS problem , Nearest-neighbor collaborative filtering (CF). User-based and item-based CF, comparison. Components of neighborhood methods (rating normalization, similarity weight computation, neighborhood selection). Hybrid recommender systems.

[6 hrs] (CO3, CO4)

Module 4: Context awareness and Learning principles in RSs

Context-aware recommender systems. Contextual information models for RSs. Incorporating context in Rs. Learning to rank. Active learning in RSs. Multi-armed bandits and Reinforcement learning in RSs. Dynamic RSs.

[6 hrs] (CO4)

Module 5: User behaviour understanding in RSs

Foundations of behavioral science. User choice and decisions models. Choice models in RSs. Digital nudging and user choice engineering principles. Applications and examples for recommender systems.

[3 hrs] (CO4)

Module 6: Applications of RSs for content media, social media and communities

Music and video RSs. Datasets. Group recommender systems. Social recommendations. Recommending friends: link prediction models. Similarities and differences of RSs with task assignment in mobile crowd sensing. Social network diffusion awareness in RSs.

[6 hrs] (CO5)

Course Outcomes:

The student will be able to:

1. Understand the basic concepts of recommender systems .
2. Solve mathematical optimization problems pertaing to recommender systems .
3. Carry out performance evaluation of recommender systems based on various metrics.
4. Implement machine-learning and data-mining algorithms in recommender systems data sets.
5. Design and implement a simple recommender system.

Suggested Books:

1. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.

Reference Books:

1. F. Ricci, L Rokach, B. Shapira and P.B. Kantor, Recommender systems handbook, Springer 2010.
2. J. Leskovec, A. Rajaraman and J. Ullman, Mining of massive datasets, 2nd Ed., Cambridge, 2012. (Chapter 9).

Course Code: BTAIML606-20	**Course Title:** Recommender System Lab	0L:0T:4P	2Credits

List of Experiment:

Part 1. Getting ready for recommender systems

Task1:What is a recommender?

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Task 2: Taxonomy of recommender systems

Task 3: Machine learning and the Netflix Prize.

Task 4: The MovieGEEKs website.

Task 5: Building a recommender system.

Task 6: User behavior and how to collect it.

Task 7: Monitoring the system.

Task 8: Ratings and how to calculate them.

Task 9: Non-personalized recommendations.

Task 10: The user (and content) who came in from the cold.

Part 2. Recommender algorithms

Task11: Finding similarities among users and among content.

Task 12: Collaborative filtering in the neighbourhood.

Task13: Evaluating and testing your recommender.

Task14: Content-based filtering.

Task15: Finding hidden genres with matrix factorization.

Task 16: Taking the best of all algorithms: Implementing hybrid recommenders.

Task17: Ranking and learning to rank.

Task 18: Future of recommender systems.

Lab Outcomes:

The student will be able to:

1. How to collect data and how to use it when you add a recommender system to your application.

2. Learn the difference between a recommendation and an advertisement, and between a personal recommendation and a non-personal one.

3. Learn how to gather data to build your own recommender system.

4. Learned about the ecosystem and infrastructure around recommender systems.

5. Learn how collaborative filtering is implemented in MovieGEEKs.

6. Evaluating the effectiveness of a recommender algorithm.

7. Splitting data sets into training data and test data.

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8. Building offline experiments to evaluate recommender systems.

9. Understanding of online testing.

Reference Books:

Practical Recommend Systems by Kim Falk.

Course Code: BTAIML607-20	**Course Title:** Advance Computing and Network Technologies	3L:0T:0P	**4 Credits**

Prerequisite: Basic knowledge of Networking and its protocols.

UNIT-I

Cloud computing concepts: Introduction to virtualization techniques, Hypervisors, Types of hypervisors, Multitenancy, Application programming interfaces (API), Elasticity and scalability. Cloud service models and its architectures, Infrastructure as a service (IaaS) architecture, Platform as a service (PaaS), Software as a service (SaaS) architecture, Comparison of cloud service delivery models. Cloud deployment models and its types- Public clouds, Private clouds, Hybrid clouds, Community clouds, Migration paths for cloud, Selection criteria for cloud deployment. Mobile Cloud Computing,

Google App Engine- Azure Services Platlbrm, Amazon EC2. Amazon 53, Migrating to the Cloud-Issues and Approaches.

[10 hrs] CO1

UNIT-2

Fog Computing: Fog Computing, Characteristics, Application Scenarios, Issues and challenges. Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction , WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.

Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background , Network Slicing in 5G , Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog , Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds , IoT Integration , Security Management for Edge Cloud Architectures. [11 hrs] CO2

UNIT-3

Wireless Networking : Primer on wireless communications and networking

Physical layer: OFDM and 802.11 (WiFi) PHY, Multi-antenna systems and MIMO, Overview of 802.11n/ac PHY including beam forming MAC layer: CSMA/CA and WiFi MAC overview, Wide bandwidth channel access techniques (802.11n/ac), Energy efficiency and rate control

Multi-gigabit wireless networks : Next generation (5G) wireless technologies, Upper Gigahertz and Terahertz wireless communications, Millimeter wave networking, Directionality and beamforming, Mobility and signal blockage, IEEE 802.11ad (60 GHz WLAN) MAC and PHY overview, Visible light communication, High-speed networking using LEDs, IEEE 802.15.7

PHY and MAC overview, Sensing through visible light, Visible light indoor localization and positioning Future mobile networks : Drone networking: Multi-UAV networks, architectures and civilian applications, Communication challenges and protocols for micro UAVs, Connected and autonomous cars: Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications, Automotive surrounding sensing with GHz and THz signals

[11 hrs] CO3

UNIT-4

Wireless Sensor Networks (WSNs): Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks. Wireless Networks, Issues in Ad hoc wireless networks, Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On—Demand Routing protocols. Networking concept and mac protocols - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, MAC Protocols for wireless sensors Networks, Low duty cycle Protocols and Wakeup concepts, S-MAC, Contention based protocols -PAMAS schedule-based protocols —LEACH, IEEE 802.15.4. MAC protocols, Energy efficient routing challenges and issues in transport layer. Challenges for Wireless Sensor Networks

Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture- Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture- Sensor Network Scenarios, Transceiver Design Considerations.

[11 hrs] CO4

Course Outcomes:

The student will be able to:

CO1: Understand the core concepts of the cloud computing paradigm. Analyze various cloud computing service and deployment models and apply them to solve problems on the cloud.

CO2: Understand advanced architectures of Cloud and their applications in FOG and Edge computing

CO3: Understand wireless network trends and build foundations for latest wireless and mobile networks

CO4: Explains the applications of ad hoc and wireless sensor networks and apply the knowledge to identify appropriate physical and MAC layer protocols.

Suggested Readings/ Books:

1. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, "Cloud Computing: A practical Approach", McGraw Hill, 2010.
2. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
3. Wireless Networking Complete, by Pei Zheng et al., Morgan Kaufmann.
4. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama.
5. Amir Vahid Dastjerdi and Rajkumar Buyya, —Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne

Reference Books

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley, 2011.
2. Labiod. H, "Wireless Adhoc and Sensor Networks", Wiley, 2008

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3. Wireless Communications: Principles and Practice, by Theodore S. Rappaport, Prentice Hall.

Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press.

Course Code: BTAIML608-20	Course Title: Advance Computing and Network Technologies Lab	0L:0T:2P	1 Credits

List of Experiment:

Task 1: Enlist various companies in cloud business and the corresponding services provided by them and tag them under SaaS, PaaS & IaaS.

Task 2: Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S. Learn creation, migration, cloning and managing of virtual machines.

Task 3: Setting up a private cloud using open-source tools (Eucalyptus/Open Stack etc.).

Task 4: Network Simulator installation of wireless sensor network.

Task 5: Write TCL script for transmission between mobile nodes.

Task 6: Write TCL script for sensor nodes with different parameters.

Task 7: Generate TCL script for UDP and CBR traffic in WSN nodes.

Task 8: Generate TCL script for TCP and CBR traffic in WSN nodes.

Task 9: Write a program to transfer a file from one system to another system using TCP and UDP sockets.

Task 10: Write a program to demonstrate communication between different processes using IPC.

Task 11: Write a Program to implement Routing Information Protocol (RIP) for a set of nodes

Task 12: Create a network of multiple routers and hosts to simulate RED and Drop Tail Queuing algorithm.

Task 13: Write a program to simulate Group Communication and implement Carrier sensing techniques.

Lab Outcomes:

The student will be able to:

CO1: Identify major commercial projects in the field of cloud computing.

CO2: Build and implement Wireless Sensor Network.

CO3: Design IoT applications in different domain and be able to analyse their performance.

CO4: Implement basic IoT applications on embedded platform with cloud storage.

Suggested Tools –Matlab, Cloudsim, Arduino, Raspberry Pi, Device Hive.

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Suggested Readings/ Books:

1.Andrew King, "Programming the Internet of Things: An Introduction to Building Integrated,

Device-to-Cloud IoT Solutions" O'Reilly 2021.

2.Rajesh Singh Anita Gehlot, "IoT based Projects: Realization with Raspberry Pi, NodeMCU", BPB Publications, 2020.

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Course Code: BTCS601-18	Course Title : Compiler Design	3L:0T:0P	3Credits

Detailed Contents:

UNIT 1: Unit I Introduction to Compilers:
Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.

[8 hrs., CO 1]

Unit II :Syntax Analysis:
Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar, Top-Down Parsing – General Strategies Recursive Descent Parser – Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0) Item Construction of SLR Parsing Table - Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer-YACC.

[8 hrs., CO 2]

Unit III : Intermediate Code Generation:
Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

[8 hrs., CO 3]

Unit IV: Run-Time Environment and Code Generation:

Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management – Issues in Code Generation – Design of a simple Code Generator.

[6 hrs., CO 4]

Unit V: Code Optimization
Principal Sources of Optimization – Peep-hole optimization – DAG- Optimization of Basic Blocks-Global Data Flow Analysis – Efficient Data Flow Algorithm.

[6 hrs., CO 5]

Course Outcomes:
After undergoing this course, the students will be able to:
CO1: Build concepts on lexical analysis.
CO2: Understand strategies of syntax analysis.
CO3: Learn techniques of Intermediate code generation.
CO4: Undestand code design issues and design code generator.
CO5: Design and develop optimized codes.

Suggested Readings/ Books:

1. A.V. Aho, Monica, R.Sethi, J.D.Ullman, "Compilers, Principles, Techniques and

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Tools", Second Edition, Pearson Education/Addison Wesley, 2009.
2. Andrew W. Appel, "Modern Compiler Implementation in Java", Second Edition, 2009.
3. J.P. Tremblay and P.G. Sorrenson, "The Theory and Practice of Compiler Writing", McGraw Hill, 1985.

Course Code: BTAIML701-20	Course Title: Computer Vision	L:3;T:0; 2P	3Credits

Total No. of Lectures – 42

		Number of Lectures
UNIT 1	**Introduction to Digital Image Processing:** The Origins of Digital Image Processing, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels. **Intensity transformation and Spatial Filtering:** Image negation, Log transformations, Power law transformation, Smoothing Spatial Filters, Sharpening Spatial Filters.	6 CO1,2
UNIT 2	**Filtering in Frequency Domain**: Preliminary Concepts, The Discrete Fourier Transform (DFT) of One Variable, The Discrete Fourier Transform of Two Variables, Properties of 2-D DFT, Smoothing Spatial Filters, Sharpening Spatial Filters, Fast Fourier Transform. **Image Restoration:** Model for Image Degradation/Restoration Process, Noise Models, Restoration by Spatial Filtering, Restoration by Frequency Domain Filtering, Homographies	10 CO2
UNIT 3	**Color Image Processing:** Color Models, Pseudo color Image Processing, Color Transformations, Color Image Smoothing and Shapening. **Wavelets and Multiresolution Processing:** Image Pyramids, Haar Transform, Multiresolution Expansion, Wavelet Transform in 1-D. **Morphological Image Processing:** Erosion and Dilation, Opening and Closing, Hit or Miss Transformation, Basic Morphological Algorithms.	12 CO2,3
UNIT 4	**Stereo and multi-view reconstruction, Structure-from-Motion** projection matrices, camera calibration, epipolar geometry, fundamental and essential matrices, disparity maps, optical flows, volumetric shape reconstruction from window-based towards regularization-based stereo, loss functions	10 CO4
UNIT 5	**Object Recognition:** Pattern and Pattern Classes, Object recognition methods.	4 CO4

Course Outcomes: At the end of the course, students will be able to:
1. Design and implement spatial domain filters.
2. Implement smoothing and sharpening operators.

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3. High pass and low pass filters for smoothing and sharpening of images.
4. Learn multi view and motion structure

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Digital Image Processing /Gonzalez Rafael C. and Woods Richard E./ Prentice–Hall of India	2011
2	Digital Image Processing/ Pratt William K./ PIKS Inside(3rd ed.), New Jersy: John Wiley & Sons, Inc.	2001
3	Digital Image Processing/ Bernd Jahne/ Springer	2002
4	Fundamentals of Digital Image Processing/ Annadurai S. and Shanmuga lakshmi R./ New Delhi: Pearson Education	2007
5	Digital Image Processing: An Algorithmic Approach,/ Joshi M.A./ New Delhi: Prentice Hall of India	2006

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ELECTIVE IV

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Course Code: BTAIML 703-20	Course Title Natural Language Processing and Information Retrieval	3L:0 T: 0P	Credits: 3

Detailed Contents:

UNIT I INTRODUCTION **CO1, 6hrs.**

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues - Applications - The role of machine learning - Probability Basics –Information theory – Collocations -N-gram Language Models - Estimating parameters and smoothing - Evaluating language models.

UNIT II MORPHOLOGY AND PART OF SPEECH TAGGING **CO1, 6hrs.**

Linguistic essentials - Lexical syntax- Morphology and Finite State Transducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models – Transformation based Models - Maximum Entropy Models. Conditional Random Fields

UNIT III SYNTAX PARSING **CO2, 4hrs.**

Syntax Parsing - Grammar formalisms and treebanks - Parsing with Context Free Grammars - Features and Unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs

UNIT IV SEMANTIC ANALYSIS **CO2, 6 hrs.**

Representing Meaning – Semantic Analysis - Lexical semantics –Word-sense disambiguation - Supervised – Dictionary based and Unsupervised Approaches - Compositional semantics, Semantic Role Labeling and Semantic Parsing – Discourse Analysis.

UNIT V Machine Translation (MT) **CO3, 6 hrs.**

Basic issues in MT-Statistical translation-word alignment- phrase-based translation – Question Answering.

UNIT VI Information Retrieval (IR) **CO4, 12 hrs**

Information Retrieval-1: Introduction, Design Features of Information Retrieval systems, Information Retrieval Models, Classical Information Retrieval Models, Non-classical models of IR, Alternative Models of IR, Evaluation of the IR Systems . Natural Language Processing in IR, Relation Matching, Knowledge-base Approaches, Conceptual Graphs in IR, Cross-lingual Information Retrieval.

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

1. Describe the fundamental concepts and techniques of natural language processing.
2. Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each.
3. Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.

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4. Analyze large volume text data generated from a range of real-world applications like IR

Text Books:

1. Daniel Jurafsky and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition. Prentice-Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

Course Code: BTAIML 704-20	**Course Title Natural Language Processing and Information Retrieval Lab**	**0L:0 T: 2P**	**Credits: 1**

Objectives: To describe the techniques and algorithms used in processing (text and speech) natural languages.

List of Experiments:

1. Write a program for word analysis
2. Write a program for word generation
3. Write a program for morphology study
4. Write a program for POS tagging using hidden markov model
5. Write a program for building chunker
6. Write a program for Robust and Scalable Parsing on Noisy Text in Web documents
7. Write a program on rule based machine translation

Students can be encourage to make a mini project on Speech recognition using NLP

Reference Books:

1. James A., Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008
4. Jurafsky, Dab and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.

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Course Code: BTAIML 705-20	Course Title: Network Security Applications using AI	3L:0 T: 0P	Credits: 3

Unit1

Need of machine learning in Network Security, Overview of machine learning classifiers: Logistic Regression, Decision Tree, Random Forest, SVM, meaning of machine learning model, training, testing, validation and cross validation of machine learning models, confusion matrix and related terms: true positive, false positive, true negative, false negative, computation and meaning of performance metrics of machine learning models: Accuracy, Precision, Recall, F1-Score, ROC and AUC, underfitting and overfitting, tuning your models for better performance

Unit2

Understanding Credit Card Fraud, Recent Credit Card Fraud incidents and their financial implications, exploring datasets for credit card fraud, investigation of shallow and deep learning models for credit card fraud detection in terms of various performance metrics

Unit3

What is e-mail spamming? Incidents of e-mail-spamming, Datasets related to e-mail spamming, Natural language processing of e-mails for spam detection, empirical analysis of machine learning models in terms of Accuracy, Precision, Recall, F1-Score, AUC

Unit4

Overview of Intrusion Detection, Network Based Intrusion, Various types of Network Intrusions, Motivation behind Network based Intrusion Detection, Datasets for Network Based Intrusion Detection, statistical characteristics of mostly used datasets, data preprocessing, comparative analysis of shallow machine learning classifiers, deep learning models for intrusion detection

Reference books and URLs:

1. Machine Learning by E. Alpaydin, MIT Press, 2010
2. Dataset for machine learning at https://www.kaggle.com/datasets
3. Dataset for Network based intrusion https://www.caida.org/catalog/datasets/completed-datasets/

Course Code: BTAIML706-20	**Course Title:** Network Security Applications using AI Lab	0L:0T:2P	1Credits

List of practical:

1. Development of fine tuned model for Credit Card Fraud detection
2. Development of fine tuned model for detection of e-mail spam

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3. Development of find tuned model for Network based Intrusion Detection
4. Deployment of machine learning models
5. Empirical analysis of various machine learning models

Course Code: BTAIML707-20	Course Title: Robotics and Intelligent systems	3L:0T:0P	3Credits

Detailed Contents:

Module 1: Introduction

Overview and Preliminaries, Introduction, History of Robotics, Mobile Robots, Position, and Orientation, Translational and Rotational Dynamics, Flying and Swimming Robots, Articulated Robots Transformation, Path Planning, and Trajectories, Time Response of Dynamic Systems, Dynamic Effects of Feedback Control.

[8 hrs] (CO1)

Module 2:

Control Systems, Sensors and Actuators, Sensor (Tactile, Range Finders, GPS, IMU, Position Encoders). Actuators. Locomotion. Manipulators.

[8 hrs] (CO2)

Module 3:

Introduction to Optimization, Numerical Optimization, Dynamic Optimal Control, Formal Logic, Algorithms, and Incompleteness.

[8 hrs] (CO3)

Module 4:

Computers, Computing, and Sets, Probability and Statistics.

[8 hrs] (CO3)

Module 5:

Machine Learning, Introduction to Neural Networks, Neural Networks, Information, Search, and Expert Systems, State Estimation, Stochastic Control, Parameter Estimation and Adaptive Control, Task Planning and Multi-Agent System.

[10 hrs] (CO4)

Course Outcomes:

The student will be able to:

1. Gain knowledge about different types of robots
2. Understand the concepts of various kinds of sensors and their utilities.
3. Recognize different modules for understanding the concepts of optimization.
4. Understand the concepts and Machine learning.

Reference Books:

Robotics

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- H. Asada and J.-J. Slotine, *Robot Analysis and Control*, J. Wiley & Sons, 1986.
- C. Asfahl, *Robots and Manufacturing Automation*, J. Wiley & Sons, 1992.
- D. Auslander, J. Ridgely, and J. Ringgenberg, *Control Software for Mechanical Systems*, Prentice-Hall, 2002.
- G. Bekey, *Autonomous Robots*, MIT Press, 2005.
- M. Brady, J. Hollerbach, T. Johnson, T. Lozano-Perez, and M. Mason, *Robot Motion: Planning and Control*, MIT Press, 1984.
- H. Choset, *Principles of Robot Motion*, MIT Press, 2005.
- C. Close and D. Frederick, *Modeling and Analysis of Dynamic Systems*, Houghton Mifflin, 1993.

Intelligent Systems

- Albus, J. I., and Meystel, A. M., *Engineering of Mind*, J. Wiley & Sons, 2001.
- P. Antsaklis and K. Passino, *An Introduction to Intelligent and Autonomous Control*, Kluwer, 1993.
- R. Arkin, *Behavior-Based Robotics*, Bradford, 1998.
- P. Baldi and S. Brunak, *Bioinformatics*, Bradford, 1998.
- C. Bishop, *Neural Networks for Pattern Recognition*, Oxford University Press, 1995.
- R. Brooks, *Cambrian Intelligence*, Bradford, 1999.

Course Code: BTAIML708-20	**Course Title:** Robotics and Intelligent systems Lab	0L:0T:4P	2Credits

List of Experiments:

1. Understand the core concepts and terminologies of robotics.
2. Create 2D and 3D drawings of robots using freeware such as LibreCAD and Blender.
3. Simulate your robot using ROS and Gazebo.
4. Build robot hardware from the requirements.
5. Explore a diverse range of actuators and its interfacing.
6. Interface various robotic sensors to robots.
7. Set up and program OpenCV, OpenNI, and PCL to process 2D/3D visual data.
8. Learn speech processing and synthesis using Python.
9. Apply artificial intelligence to robots using Python.
10. Integrating Robotic Hardware and Software.
11. Build a robot control GUI using Qt and Python.
12. Calibration and testing of robot.

Reference Books:

1. Joseph, Lentin. learning Robotics using python. Packt Publishing Ltd, 2015.

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ELECTIVE V

Course Code: BTCS 704-18	Course Title : Deep Learning	3L:0T:0P	3Credits

Detailed Contents:

UNIT 1: Machine Learning Basics: Learning, Under-fitting, Overfitting, Estimators, Bias, Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning, Unsupervised Learning and Stochastic Gradient Decent.

[4hrs] (CO 1)

UNIT 2: Deep Feedforward Network: Feed-forward Networks, Gradient-based Learning, Hidden Units, Architecture Design, Computational Graphs, Back-Propagation, Regularization, Parameter Penalties, Data Augmentation, Multi-task Learning, Bagging, Dropout and Adversarial Training and Optimization.

[4hrs] (CO 2)

UNIT 3: Convolution Networks: Convolution Operation, Pooling, Basic Convolution Function, Convolution Algorithm, Unsupervised Features and Neuroscientific for convolution Network.

[6hrs] (CO 3)

UNIT 4: Sequence Modelling: Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder- Decoder Sequence-to-Sequence Architectures, Deep Recurrent Network, Recursive Neural Networks and Echo State networks.

[12hrs] (CO 4)

UNIT 5: Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Deep Boltzmann Machines, Sigmoid Belief Networks, Directed Generative Net, Drawing Samples from Auto – encoders.

[14hrs] (CO 5)

Course Outcomes:

After undergoing this course, the students will be able to:
CO1: Comprehend the advancements in learning techniques
CO2: Compare and explain various deep learning architectures and algorithms.
CO3: Demonstrate the applications of Convolution Networks
CO4: Apply Recurrent Network for Sequence Modelling
CO5: Deploy the Deep Generative Models

Suggested Readings/ Books:

Text Books:

1. *Goodfellow L., Bengio Y. and Courville A., Deep Learning, MIT Press (2016).*
2. *Patterson J. and Gibson A., Deep Learning: A Practitioner's Approach, O'Reilly (2017), 1st ed.*

Reference Books:

1. *Haykin S., Neural Network and Machine Learning, Prentice Hall Pearson (2009), 3rd ed.*
2. *Geron A., Hands-on Machine Learning with Sci-kit and TensorFlow, O'Reilly Media (2017)*

Course Code: BTCS 705-18	**Course Title: Deep Learning Lab**	**L:0;T:0; 2P:**	**Credits;1**

Detailed List of Tasks:

- Creating a basic network and analyze its performance
- Deploy the Confusion matrix and simulate for Overfitting
- Visualizing a neural network
- Demo: Object Detection with pre-trained RetinaNet with Keras
- Neural Recommender Systems with Explicit Feedback
- Backpropagation in Neural Networks using Numpy
- Neural Recommender Systems with Implicit Feedback and the Triplet Loss
- Fully Convolutional Neural Networks
- ConvNets for Classification and Localization
- Text Classification and Word Vectors
- Character Level Language Model (GPU required)

Suggested Tools Python/R/MATLAB

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Course Code: BTAIML709-20	**Course Title:** Applied Intelligence	3L:0T:0P	3Credits

Pre-requisites: AI

Detailed Contents:

Module 1: Statistical Learning Methods

Introduction to statistical learning, Statistics fundamentals: probability, random variables, description statistics and stochastic processes, Statistical inference: estimation and testing, evaluation metrics, Bayesian methods: Naive Bayes and Bayesian Networks, Markov processes and chains, Kalman estimators, Statistical modelling and decision making: regression, mixture models and classification approaches, Case study: application of statistical learning for aerospace sector problem. [8 hrs] (CO1)

Module 2: Systems Engineering

Systems challenges, The systems process, Understanding systems, Capability need and requirements, System design and architecture, System evaluation, verification and validation, The impact of organisation on Systems Engineering, People, skills and competencies in Systems Engineering. [8 hrs] (CO1, CO2)

Module 3: Intelligent Cyber Physical Systems

Cyber-physical systems: Control, sensor and actuators, Intelligent agent and multi-agent, Intelligent robotics, Embedded systems, Connected system, Countermeasures.

[8 hrs] (CO3, CO4)

Module 4: Logic and Automated Reasoning

Introduction to logical representation and reasoning, Logical Agents, Propositional Logic, First-order Logic, Inference Algorithms, Engineering domain knowledge representation, Exercises and case studies [8 hrs] (CO3, CO4)

Module 5: Deep Learning

Artificial Neural Networks (Shallow models), Backpropagation and Training, Deep learning architectures, Convolutional Neural Networks, Recurrent neural networks, Deep learning applications: object detection, identification, classification, tracking, prediction, Introduction to Reinforcement learning, Tensorflow practical sessions on Artificial, Convolutional and Recurrent Neural Networks. [10 hrs] (CO5)

Course Outcomes:

The student will be able to:

1. Explain fundamental meaning and discuss applicability of machine learning algorithms for industrial applications.
2. Test the commonly used AI algorithms and describe their applications.
3. Implement AI algorithms, estimate their performance in a simulation environment and assess their performance for a realistic case study.
4. Judge AI implementation platforms and create deep learning applications for specific problems.
5. Assess the outcomes of the statistical learning.

Suggested Books:

1. Sternberg, R., Kaufman, J., & Grigorenko, E. (2008). Applied Intelligence. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511611445

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Reference Books:

1.Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
3. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India,
5. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010

Course Code: BTAIML710-20	**Course Title:** Applied Intelligence Lab	0L:0T:2P	1Credits

List of Experiment:

Detailed List of Tasks:

1.Write a programme to conduct uninformed and informed search.
2. Write a programme to conduct game search.
3. Write a programme to construct a Bayesian network from given data of any health sector data set
4. Write a programme to infer from the Bayesian network on the above dataset
5. Write a programme to run value and policy iteration in a grid world in real world problem
6. Write a programme to do reinforcement learning in a grid world in real world problem

Lab Outcomes:

Upon successful completion of the course, the student will be able to

CO1 Apply various pre-processing techniques on different datasets.
CO2 Construct Machine learning programs for Supervised, Unsupervised and Semi supervised learning models.
CO3 Develop Deep learning programs for Supervised & Unsupervised learning models.
CO4 Identify and Apply Applied Intelligence concepts to solve real world problems.

Suggested Books:

1. Sternberg, R., Kaufman, J., & Grigorenko, E. (2008). Applied Intelligence. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511611445

Reference Books:

1.Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
3. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India,
5. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010

Course Code: BTAIML711-20	**Course Title:** Augmented and Virtual reality	3L:0T:0P	3Credits

Course Details:

UNIT 1:

Introduction to Virtual and Augmented Reality (VR/AR) Systems, Definition and Overview of VR/AR, History and Evolution of VR/AR, Applications of VR/AR (4hrs.)
Technical Aspects of Virtual Reality, Virtual Reality Hardware and Peripherals, Virtual Reality Software and Development Tools, Integration of Virtual Reality Systems with Other Technologies (7hrs.)
CO1

UNIT 2:

Design and Development of VR/AR Applications, Conceptualization and Prototyping of Virtual Reality Applications, User Experience Design in Virtual Reality, Implementation of Virtual Reality Applications using Unity and Unreal Engine (15hrs.)
CO2

UNIT 3:

Evaluation of Virtual Reality Systems and Technologies, Usability and User Testing of Virtual Reality Systems, Performance Analysis and Optimization of Virtual Reality Applications, Comparison and Evaluation of Different Virtual Reality Technologies (5hrs.)
CO3

UNIT 4:

Applications of VR/AR in Various Fields, VR/AR in Education and Training, VR/AR in Entertainment and Gaming, VR/AR in Engineering and Manufacturing (7hrs.)
Challenges and Limitations in VR/AR, Emerging Trends and Future Directions in VR/AR (2hrs.)
CO4

COURSE OUTCOMES:

CO1 Learn the fundamentals concepts of virtual reality and its applications, technical concepts of virtual reality systems, including hardware and software components.
CO2 Design and develop virtual reality applications using industry-standard tools and techniques.
CO3 Evaluate the limitations and strengths of various virtual reality systems and technologies.
CO4 Apply virtual reality technology to solve real-world problems in various fields, including education, entertainment, and engineering.

Recommended Books:

1. Creating Augmented & Virtual Realities, Erin Pangilinan, Steve Lukas, Vasanth Mohan, Shroff/O'Reilly
2. Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications, Jesse Glover, Jonathan Linowes, Packt Publishing Limited
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B. Craig, Jeffrey D. Will, William R. Sherman, Morgan Kaufmann Publisher

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4. Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions, Jonathan Linowes, Packt Publishing Limited
5. 3D Game Design with Unreal Engine 4 and Blender: Design and create immersive, beautiful game environments with the versatility of Unreal Engine 4 and Blender, Justin Plowman, Ingram

Course Code: BTAIML712-20	**Course Title:** Augmented and Virtual Reality lab	L:0T:2P	1Credits

1. Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2. Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3. Develop a scene in Unity that includes: i. a cube, plane and sphere, apply transformations on the 3 game objects. ii. add a video and audio source.
4. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click.
5. Develop a scene in Unity that includes a sphere and plane . Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using vr controller.
6. Develop a simple UI(User interface) menu with images, canvas, sprites and button. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene ..
7. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
8. Include animation and interaction in the immersive environment created in Assignment 7.

Programming tools recommended: - Unity, C#, Blender, VRTK. VR Devices: HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR

1.3.4 Percentage of students undertaking field projects / research projects / internsh
academic year)(5)

1.3.4.1:Number of students undertaking field project or research projects or internshi

Programme name	Program Code
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech
B Tech	B Tech

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Metric No.		Weightage
1.1.1 **QlM**	***Curricula developed and implemented have relevance to the local, national, regional and global developmental needs which is reflected in Programme outcomes (POs), Programme Specific Outcomes (PSOs) and Course Outcomes (COs) of the Programmes offered by the University*** Write description in maximum of 500 words The Department of Electronics and Communication Engineering at IKGPTU, Main Campus Kapurthala is offering B.Tech. Electronics and Communication Engineering (ECE), B.Tech. Artificial Intelligence & Machine Learning and M.Tech. ECE Wireless Communication programmes at Undergraduate and Post Graduate levels, respectively. The main objective of these programmes is to impart quality education and create skilled technocrats & innovative entrepreneurs that meet to National as well as Global challenges in the area of Electronics and Communication Engineering (ECE) at under graduate level. For this, the University has undergone, updated, revised and modified the whole Scheme and syllabus on the latest guidelines. Revised Curricula that has been developed and implemented by the University has the ability to generalize fundamental domain knowledge while working with electronic equipment/systems to handle engineering problems in professional career and to get profound knowledge of modern techniques, EDA tools and to acquire technical skills to innovate new/existing solutions to engineering problems. It is the objective of the programme that Graduates will be known leaders in Electronics and Comm. Engineering and associated domains of engineering due their ability solve real-world inter-disciplinary problem. For this, new and advanced courses have been added like - the Program Elective Groups/courses have been categorized/developed keeping in mind the employment prospects of the students. The Program design in B.Tech. ECE aims at providing domain specific knowledge to a student at UG level in progression. The Programme/course design has been carried out jointly by the Academia in close coordination with Industry to provide a leading edge to the students and to prepare them as per the industry needs. Some of the advanced courses that have been added are Internet of Things & Cloud Computing, Robotics and Embedded systems, Artificial Intelligence and Machine Learning, JAVA and Python Programming, Mobile Adhoc Networks, Introduction to Big Data, Soft Computing, Artificial Neural Networks, etc. All such	20

	courses are now the need of the hour as these are major requirements for the relevance to the needs for National and Global development. The main aim of the curricula is to impart outcome-based and continuously evolving curriculum by inculcating comprehensive domain knowledge to develop professional competence for meeting sustainable industrial and societal expectations. Moreover, ability to provide solutions to real-world problems in the field of Electronics & Communication Engineering by extrapolating the fundamental knowledge of electronic devices, circuits, embedded & communication systems. It is also important that the important outcome from the programme includes Innovative thinking and ability to design and/or improve products and/or systems for the society and industry for better utilization, human safety and reduced cost. **File Description** • Upload Additional information NIL • Link for Additional information: https://ptu.ac.in/wp-content/uploads/2020/10/6-12-18M_Tech_ECE__WIRELESS_COMMUNICATION.pdf https://ptu.ac.in/wp-content/uploads/2021/12/BTech-ECE-2021.pdf https://ptu.ac.in/wp-content/uploads/2023/04/B.Tech_._ECE__Upto_8th_Sem._2019__Main_Campus__onwards-2.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2023/08/B_Tech_Computer-Science-Engg_Artificial-Intelligence-Machine-Learning-upto-8th-Sem_batch-2020-onwards.pdf	

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Metric No.	
1.2.1 QnM	***Percentage of new courses introduced of the total number of courses across all programmes offered during the last five years*** 2018, 2019, 2020, 2021, 2022-Yes as given below: **Annexure 1.2.1 - ECE** 1.2.1.1: How many new courses were introduced within the last five years = 81 1.2.1.2 : Number of courses offered by the institution across all Programmes during the last five years= 95 Data Requirement for last five years: (As per Data Template) • Name of the new course introduced • Name of the Programme Formula: $\frac{\textbf{Number of new courses introduced during the last five years}}{\textbf{Number of courses offered during the last five years}}$ **X 100= 81/95=85.26%** **File Description (Upload)** • Minutes of relevant Academic Council/BOS meeting: **Links as below:** https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-05-March-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-25-April-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-08-Sept-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-29-Sept-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-24April-2018.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-19-July-2018.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-Feb-2019.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-03-Dec-2020.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-May-2021.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-13-Sept-2019.pdf • List of new courses introduced during the last five years: **Annexure 1.2.1 – ECE (1 course was replaced)** • Institutional data https://ptu.ac.in/wp-content/uploads/2020/10/6-12-18M_Tech_ECE__WIRELESS_COMMUNICATION.pdf

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https://ptu.ac.in/wp-content/uploads/2023/04/B.Tech_._ECE_Upto_8th_Sem._2019_Main_Campus_onwards-2.pdf

https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf

https://ptu.ac.in/wp-content/uploads/2021/12/BTech-ECE-2021.pdf

https://ptu.ac.in/wp-content/uploads/2023/08/B_Tech_Computer-Science-Engg_Artificial-Intelligence-Machine-Learning-upto-8th-Sem_batch-2020-onwards.pdf

- List of new courses introduced program-wise during the assessment period certified by the Registrar:
  Annexure 1.2.1 – ECE
- Minutes of relevant Academic Council/BOS meeting: **Links as below:**

1. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-05-March-2015.pdf
2. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-25-April-2015.pdf
3. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-08-Sept-2015.pdf
4. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-24April-2018.pdf
5. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-19-July-2018.pdf
6. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-Feb-2019.pdf
7. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-03-Dec-2020.pdf
8. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-May-2021.pdf
9. https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-13-Sept-2019.pdf

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1.2.2	***Percentage of Programmes in which Choice Based Credit System (CBCS)/elective course system has been implemented (Data for the latest completed academic year)***
QnM	1.2.2.1: Number of Programmes in which CBCS/ Elective course system implemented. 2018- Elective course system 2019-Elective course system 2020-Elective course system 2021-Elective course system 2022-Elective course system Data Requirements: (As per Data Template) • Names of all Programmes adopting CBCS/Elective course system: -B.Tech (Electronics and Communication Engineering) -B.Tech (Artificial Intelligence & Machine Learning) -M.Tech. ECE (Wireless Communication) Formula: $\frac{\text{Number of Programmes in which elective course system implemented}}{\text{Total number of Programmes offered}}$ **X 100= 4/5*100=80%** **File Description links:** https://ptu.ac.in/wp-content/uploads/2020/10/6-12-18M_Tech_ECE__WIRELESS_COMMUNICATION.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2021/12/BTech-ECE-2021.pdf https://ptu.ac.in/wp-content/uploads/2023/04/B.Tech_._ECE__Upto_8th_Sem._2019__Main_Campus__onwards-2.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2023/08/B_Tech_Computer-Science-Engg_Artificial-Intelligence-Machine-Learning-upto-8th-Sem_batch-2020-onwards.pdf

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		• List of programs in which CBCS / Elective course system implemented in the last academic year: B.Tech (Electronics and Communication Enhgineering) M.Tech. ECE (Wireless Communication) **Annexure 1.2.2 – ECE** • Minutes of relevant Academic Council meeting: **Academic Council Implementing CBCS.** https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-05-March-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-25-April-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-08-Sept-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-29-Sept-2015.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-24April-2018.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-19-July-2018.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-Feb-2019.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-03-Dec-2020.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-18-May-2021.pdf https://ptu.ac.in/wp-content/uploads/2021/09/Meeting-13-Sept-2019.pdf • Institutional data in prescribed format: https://ptu.ac.in/wp-content/uploads/2020/10/6-12-18M_Tech_ECE__WIRELESS_COMMUNICATION.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2023/08/B_Tech_Computer-Science-Engg_Artificial-Intelligence-Machine-Learning-upto-8th-Sem_batch-2020-onwards.pdf • University letter stating implementation of CBCS: https://ptu.ac.in/wp-content/uploads/2020/10/4-12-18Final-CBS-29_Sept_2016.pdf • Structure of the program clearly indicating courses, credits / electives as approved by the competent board: **Link provided**

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	https://ptu.ac.in/wp-content/uploads/2020/10/6-12-18M_Tech_ECE__WIRELESS_COMMUNICATION.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf https://ptu.ac.in/wp-content/uploads/2023/08/B_Tech_Computer-Science-Engg_Artificial-Intelligence-Machine-Learning-upto-8th-Sem_batch-2020-onwards.pdf https://ptu.ac.in/wp-content/uploads/2021/08/Annexure_II_Final_Main_Campus_B.pdf • Any additional Information: NIL

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Study Scheme & Syllabus of

Bachelor of Technology

Electronics & Communication Engineering

Batch 2021 onwards

(3^{rd} -8^{th} Semester)

For

University Main Campus, Constituent Campuses and Affiliated colleges

Department of Academics

I.K. Gujral Punjab Technical University

Structure of Distribution of credits Electronics & Communication Engineering Program as per AICTE Model Curriculum 2018:

Sr. No.	Category	Suggested Breakup of Credits (Total 160)
1	Humanities and Social Science including Management courses	12*
2	Basic Sciences courses	25*
3	Engineering Science courses-including workshop, drawing, basics of electrical/mechanical/computer etc.	24*
4	Professional Core courses	48*
5	Professional Elective courses relevant to chosen specialization/branch	18*
6	Open subjects - Electives from other technical and/or emerging subjects	18*
7	Project Work, Seminar and Internship in Industry or elsewhere	15*
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
	Total	160*

**Minor Variation is allowed as per need of the respective disciplines.*

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VISION

To impart quality education and create skilled technocrats & innovative entrepreneurs that meet to global challenges in the area of Electronics and Communication Engineering (ECE) at under graduate level.

MISSION

1. To impart outcome-based curriculum inculcating comprehensive fundamental domain knowledge meant to meet current industrial expectations.
2. To provide state-of-the-art infrastructure supported with best teaching-learning environment for practical realization of theoretical concepts.
3. To produce technocrats, researchers and entrepreneurs with inherent human values who can tackle challenges of professional career.

PROGRAMME EDUCATIONAL OBJECTIVES

1. Ability to generalize fundamental domain knowledge while working with electronic equipment/systems to handle engineering problems in professional career.
2. Ability to get profound knowledge of modern techniques, EDA tools and to acquire technical skills to innovate new/existing solutions to engineering problems.
3. Graduates will be known leaders in Electronics and Comm. Engineering and associated domains of engineering due their ability solve real-world inter-disciplinary problem.

PROGRAMME OUTCOMES (POs)

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct** investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

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9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. **Working with Instruments**: Appreciate working of electronic equipment/systems guided by practical experience and theoretical fundamental knowledge of Electronics & Communication Engineering.
2. **Extrapolating Domain Knowledge**: Ability to provide solutions to real-world problems in the field of Electronics & Communication Engineering by extrapolating the fundamental knowledge of electronic devices, circuits, embedded & communication systems.
3. **Innovation and Design Ability**: Innovative thinking and ability to design and/or improve products and/or systems for the society and industry for better utilization, human safety and reduced cost.

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Semester III [Second year]											
Branch/Course: B.Tech. Electronics and Communication Engineering											
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1	BTEC- 301-18	Electronic Devices	3	0	0	3	40	60	100	3
2	BTEC- 302-18	Digital System Design	3	1	0	4	40	60	100	4
3	BTEC- 303-18	Electromagnetic Waves	3	1	0	4	40	60	100	4
4	BTEC-304-18	Network Theory	3	1	0	4	40	60	100	4
5	BTAMXXX18	Mathematics III	3	1	0	4	40	60	100	4
6	BTEC-311-18	Electronic Devices Laboratory	0	0	2	2	30	20	50	1
7	BTEC-312-18	Digital System Design Laboratory	0	0	2	2	30	20	50	1
8	HSMC101-18 /HSMC102-18*	Foundational Course in Humanities (Development of Societies or Philosophy)	3	0	0	3	40	60	100	3
9	BTEC-321-18	4-Week Institutional Training	0	0	4	4	60	40	100	0
10	BMPD-331-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**4**	**10**	**32**	**360**	**440**	**800**	**24**

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Semester IV [Second year]											
Branch/Course: B.Tech. Electronics and Communication Engineering											
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-401-18	Analog Circuits	3	1	0	4	40	60	100	4
2	BTEC-402-18	Microprocessors and Microcontrollers	3	1	0	4	40	60	100	4
3	BTCS-301-18	Data Structures & Algorithms	3	0	0	3	40	60	100	3
4	BTEC-403-18	Signals and Systems	3	1	0	4	40	60	100	4
5	HSMC122-18	Universal Human Values – 2: Understanding Harmony	3	0	0	3	40	60	100	3
6	EVS-101-18	Mandatory Course- Environmental Sciences	3	0	0	3	100	0	100	Non-credit
7	BTEC-411-18	Analog Circuits Laboratory	0	0	2	2	30	20	50	1
8	BTEC-412-18	Microprocessors and Microcontrollers Laboratory	0	0	2	2	30	20	50	1
9	BMPD-341-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**2**	**6**	**26**	**360**	**340**	**700**	**20**

Semester V [Third year]										
Branch/Course: B.Tech. Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs.**	**Internal Marks**	**External Marks**	**Total**	**Credit**
1	BTEC-501-18	Analog and Digital Communication	3	1	0	4	40	60	100	4
2	BTEC-502-18	Digital Signal Processing	3	1	0	4	40	60	100	4
3	BTEC-503-18	Linear Integrated Circuits	3	1	0	4	40	60	100	4
4	BTEC-504-18	Control Systems	3	1	0	4	40	60	100	4
5	BTEC-901X-18	Professional Elective-1	3	0	0	3	40	60	100	3
6	BTEC-505-18	Project Management	3	0	0	3	40	60	100	3
7	BTEC-511-18	Analog and Digital Communication Laboratory	0	0	2	2	30	20	50	1
8	BTEC-512-18	Digital Signal Processing Laboratory	0	0	2	2	30	20	50	1
9	BTEC-513-18	Linear Integrated Circuits Laboratory	0	0	2	2	30	20	50	1
10	BTEC-521-18	4-Weeks Industrial Training	0	0	6	6	60	40	100	0
11	BTEC-10X-18	Professional Elective-1 Lab (Optional)**	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
12	BMPD-351-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**3**	**17**	**38**	**390**	**460**	**850**	**25**

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Semester VI [Third year]										
Branch/Course: B.Tech. Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1	BTEC-601-18	Wireless Communication	3	0	0	3	40	60	100	3
2	BTCS-504-18	Computer Networks	3	0	0	3	40	60	100	3
3	BTEC-602-18	Optical Fibers & Communication	3	1	0	4	40	60	100	4
4	BTEC-603-18	Microwave and Antenna Engineering	3	1	0	4	40	60	100	4
5	BTEC-906X-18	Professional Elective-2	3	0	0	3	40	60	100	3
6	BTEC-XXX-18	Open Elective-1	3	0	0	3	40	60	100	3
7	BTEC-611-18	Optical Fibers & Communication Lab	0	0	2	2	30	20	50	1
8	BTEC-612-18	Microwave and Antenna Engineering Laboratory	0	0	2	2	30	20	50	1
9	BTEC-631-18	Project-I	0	0	3	3	60	40	100	3
10	BTEC-11X-18	Professional Elective-2 Lab (Optional)**	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
11	BMPD-361-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**18**	**2**	**11**	**31**	**360**	**440**	**800**	**25**

Semester VII/VIII [Fourth year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hr**	**Int Marks**	**Ext Marks**	**Total**	**Credits**
1	BTEC-907X-18	Professional Elective-3	3	0	0	3	40	60	100	3
2	BTEC-908X-18	Professional Elective-4	3	0	0	3	40	60	100	3
3	BTEC-909X-18	Professional Elective-5	3	0	0	3	40	60	100	3
4	BTEC-YYY-18	Open Elective-2	3	0	0	3	40	60	100	3
5	BTEC-ZZZ-18	Open Elective-3	3	0	0	3	40	60	100	3
6	BTMC-101-18	Indian Constiution-Mandatory Course	3	0	0	3	100	0	100	Non-credit
7	BTMC-102-18	Essence of Indian Traditional Knowledge-Mandatory Course	3	0	0	3	100	0	100	Non-credit
8	BTEC-731-18	Project-II & Report	0	0	12	12	120	80	200	6
9	BTEC-12X-18	Professional Elective 3 or 4 or 5 Lab (Optional)**	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
10	BMPD-371-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**21**	**0**	**16**	**37**	**520**	**380**	**900**	**21**

Semester VII/VIII [Fourth year]						
B.Tech. Electronics and Communication Engineering						
Sr. No.	**Course code**	**Course Title**	**Internal Marks**	**External Marks**	**Total**	**Credits**

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1	BTEC- 801-18	Semester Software/Industrial Training & Project	300	200	500	16
		Total	**300**	**200**	**500**	**16**
Total Marks (including B.Tech. 1st Year)			**2680**	**3020**	**5700**	**169**

OR

If the students (minimum 8 students) of any Institute/College do not opt for semester training, then the students shall be required to study the following:

Semester VII/VIII [Fourth year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Hr**	**Int Marks**	**Ext Marks**	**Total**	**Credits**
1	BTEC-aaaa-18	Professional Elective	3	0	0	3	40	60	100	3
2	BTEC-bbbb-18	Professional Elective	3	0	0	3	40	60	100	3
3	BTEC-cccc-18	Professional Elective	3	0	0	3	40	60	100	3
4	BTEC-dddd-18	Professional Elective	3	0	0	3	40	60	100	3
5	BTEC-802-18	Simulation and Modelling Lab (Minor Project & Report)	0	0	8	8	60	40	100	4
6	BMPD-381-18	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory			Non-credit
		Total	**12**	**0**	**10**	**22**	**220**	**280**	**500**	**16**

1. Four Professional Elective subjects (each of 3 credits) from any one of the Five Professional Elective Groups (excluding the group which the student has opted earlier).
2. The student will undertake and complete a Minor Project using Simulation and Modelling Lab & submit the Report.
3. Student has to complete 16 credits equivalent to that of One semester Industrial training in this course.

* Student may choose any one of these as foundational courses in HUSS group as given in AICTE Model Curriculum 2018.

** Lab pertaining to the Professional Electives is optional and non-credit, however, it can be offered by the Department to its students as per the lab support available and the discretion of the same lies with the Institution.

PROFESSIONAL (or PROGRAM) ELECTIVE (PE) COURSES [ELECTRONICS AND COMMUNICATION ENGINEERING]

The Professional Electives are categorized into five different Groups viz. Information & Communication Technology (ICT), Communication Systems, Electronic Hardware, Software Development and Signal Processing. The Program Elective Groups/courses have been categorized/developed keeping in mind the employment prospects of the students. The Program

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design in B.Tech. ECE aims at providing domain specific knowledge to a student at UG level in progression. The Program/course design has been carried out jointly by the Academia in close coordination with Industry to provide a leading edge to the students and to prepare them as per the Industry needs.

The student is free to choose any one group out of the five listed groups. It is expected of a student to complete all the six courses from the relevant group. Therefore, the Head and the Faculty of the Department should provide complete guidance and take utmost care to apprise the students in a most diligent manner. Usually, it will not be a case to allow the change of the group, however, in the best interest of the students, a student can be allowed to change the group but the responsibility for teaching the pre requisite courses in the changed group shall rest with the Department/Institute. The permission for the same shall have to be obtained from the University with supporting reasons.

*Sr. No.	Professional Elective Group	Semester	Professional Elective	Course Code	Course Title	Hrs/week	Credits
1.	ICT Group	V	PE-1	BTEC-905A-18	Routing and Switching	3L:0T:0P	3
2.		VI	PE-2	BTEC-906A-18	WLAN and Security	3L:0T:0P	3
3.		VII	PE-3	BTEC-907A-18	Internet of Things (IoT) & Cloud Computing	3L:0T:0P	3
4.		VII	PE-4	BTEC-908A-18	Artificial Intelligence	3L:0T:0P	3
5.		VII	PE-5	BTEC-909A-18	Introduction to Big Data	3L:0T:0P	3
6.	Communication Group	V	PE-1	BTEC-905B-18	Random Variables and Stochastic Processes	3L:0T:0P	3
7.		VI	PE-2	BTEC-906B-18	Satellite Communication	3L:0T:0P	3
8.		VII	PE-3	BTEC-907B-18	Antenna Radiating Systems	3L:0T:0P	3
9.		VII	PE-4	BTEC-908B-18	Mobile Communication and Networks	3L:0T:0P	3
10.		VII	PE-5	BTEC-909B-18	Information Theory and Coding	3L:0T:0P	3
11.	Electronics Hardware Group	V	PE-1	BTEC-905C-18	VLSI/ULSI Technology	3L:0T:0P	3
12.		VI	PE-2	BTEC-906C-18	CMOS and RF Circuits Design	3L:0T:0P	3
13.		VII	PE-3	BTEC-907C-18	Robotics and Embedded systems	3L:0T:0P	3
14.		VII	PE-4	BTEC-908C-18	VLSI Design	3L:0T:0P	3
15.		VII	PE-5	BTEC-909C-18	Embedded System Design	3L:0T:0P	3
16.	Software Development Group	V	PE-1	BTEC-905D-18	Programming in JAVA	3L:0T:0P	3
17.		VI	PE-2	BTEC-906D-18	C# AND .NET Programming	3L:0T:0P	3
18.		VII	PE-3	BTEC-907D-18	Python Programming	3L:0T:0P	3

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19.		VII	PE-4	BTEC-908D-18	Soft Computing	3L:0T:0P	3
20.		VII	PE-5	BTEC-909D-18	Artificial Intelligence & Machine Learning	3L:0T:0P	3
21.	**Signal processing Group**	V	PE-1	BTEC-905E-18	Speech and Audio Processing	3L:0T:0P	3
22.		VI	PE-2	BTEC-906E-18	Natural language Processing	3L:0T:0P	3
23.		VII	PE-3	BTEC-907E-18	Adaptive Signal Processing	3L:0T:0P	3
24.		VII	PE-4	BTEC-908E-18	Digital Image and Video Processing	3L:0T:0P	3
25.		VII	PE-5	BTEC-909E-18	Biomedical Signal Processing	3L:0T:0P	3

LIST OF OPEN ELECTIVES (OE) COURSES OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING FOR STUDENTS OF OTHER PROGRAMS

Sr. No	Course Code	Sem	Course Title	L	T	P	Hours/ Week	Credits
1.	BTEC-301-18	Odd	Electronic Devices	3	0	0	3	3
2.	BTEC-302-18	Odd	Digital System Design	3	0	0	3	3
3.	BTEC-402-18	Even	Microprocessors and Microcontrollers	3	0	0	3	3
4.	BTEC-403-18	Even	Signals and Systems	3	0	0	3	3
5.	BTEC-501-18	Odd	Analog and Digital Communication	3	0	0	3	3
6.	BTEC-905A-18	Odd	Routing and Switching	3	0	0	3	3
7.	BTEC-905C-18	Odd	VLSI/ULSI Technology	3	0	0	3	3
8.	BTEC-502-18	Odd	Digital Signal Processing	3	0	0	3	3
9.	BTEC-503-18	Odd	Linear Integrated Circuits	3	0	0	3	3
10.	BTEC-504-18	Odd	Control Systems	3	0	0	3	3
11.	BTEC-601-18	Even	Wireless Communication	3	0	0	3	3
12.	BTEC-906A-18	Even	WLAN and Security	3	0	0	3	3
13.	BTEC-906B-18	Even	Satellite Communication	3	0	0	3	3
14.	BTEC-906C-18	Even	CMOS and RF Circuits Design	3	0	0	3	3
15.	BTEC-907B-18	Odd	Antenna Radiating Systems	3	0	0	3	3
16.	BTEC-907C-18	Odd	Robotics and Automation	3	0	0	3	3
17.	BTEC-908A-18	Odd	Artificial Intelligence	3	0	0	3	3
18.	BTEC-909A-18	Odd	Introduction to Big Data	3	0	0	3	3
19.	BTEC-908B-18	Odd	Mobile Communication and Networks	3	0	0	3	3
20.	BTEC-909B-18	Odd	Information Theory and Coding	3	0	0	3	3

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21.	BTEC-908C-18	Odd	VLSI Design	3	0	0	3	3
22.	BTEC-909C-18	Odd	Embedded System Design	3	0	0	3	3
23.	BTEC-908D-18	Odd	Machine Learning	3	0	0	3	3
24.	BTEC-909D-18	Odd	Soft Computing	3	0	0	3	3

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Range of credits for Honors Degree -Minimum credits as per scheme are required by a student to be eligible to get Under Graduate degree in Electronics and Communication Engineering.

1. A student will be eligible to get Under Graduate degree with Honors, if he/she completes an additional 20 credits. These could be acquired through MOOCs and registering in the department.

2.Range of Credits and Courses for Major Degree in B. Tech. (Electronics and Communication Engineering) and Minor Degree in B.Tech. (Other Engineering)

(i) A student admitted in B. Tech (ECE) may opt for Major Degree in B. Tech. (ECE) and Minor Degree in B.Tech. (other Engineering) with effect from 3rd semester onwards.

(ii) The student must clear his/her previous two semesters.

(iii) The student/candidate will require to clear at least five theory subjects for Minor Degree in B.Tech.

Subjects for Minor Degree in B.tech Electronics and Communication Engineering (ECE)

Core Subjects:

S.No.	Subject Code	Course Title	Credits
1.	BTEC-305-18	Basic Electronics	3
2.	BTEC-306-18	Digital Electronics	3
3.	BTEC-401-18	Analog Circuits	4
4.	BTEC-402-18	Microprocessors and Microcontrollers	3
5.	BTEC-403-18	Signals and Systems	4
6.	BTEC-501-18	Analog and Digital Communication	3
7.	BTEC-503-18	Linear Integrated Circuits	3
8.	BTEC-504-18	Control Systems	4
9.	BTEC-601-18	Wireless Communication	3
10.	BTEC-602-18	Digital Signal processing	4
11.	BTEC-603-18	Optical Fibres and Communication	3
12.	BTEC-604-18	Microwave and Antenna Engg.	4

Elective Subjects

S.No.	Subject Code	Course Title	Credits
1.	BTEC-301-18	Electronic Devices	3
2.	BTCS-301-18	Data Structures & Algorithms	3
3.	BTEC-905A-18	Routing and Switching	3
4.	BTEC-906A-18	WLAN and Security	3
5.	BTEC-907A-18	Cloud Computing and Services	3
6.	BTEC-905B-18	Random Variables and Stochastic Processes	3
7.	BTEC-906B-18	Satellite Communication	3
8.	BTEC-907B-18	Antenna Radiating Systems	3

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9.	BTEC-906D-18	Mobile Communication and Networks	3
10.	BTEC-906E-18	Satellite Communication	3

11.	BTEC-907A-18	VLSI/ULSI Technology	3
12.	BTEC-907B-18	Embedded System Design	3
13.	BTEC-905C-18	VLSI/ULSI Technology	3
14.	BTEC-906C-18	CMOS and RF Circuits Design	3
15.	BTEC-905D-18	Programming in JAVA	3
16.	BTEC-906D-18	C# AND .NET Programming	3
17.	BTEC-905E-18	Speech and Audio Processing	3
18.	BTEC-906E-18	Natural language Processing	3
19.	BTEC-909C-18	Adaptive Signal Processing	3

MANDATORY COURSES (Non-Credit Courses)

Sr. No.	Mandatory Course	Course Code	Course Title	Hours/Week	Credits
1.	MC-1	BTMC-XXX-18	Environmental Sciences	3L:0T:0P	Nil
2.	MC-2	BTMC-YYY-18	Indian Constitution	3L:0T:0P	Nil
3.	MC-3	BTMC-ZZZ-18	Essence of Indian Traditional Knowledge	3L:0T:0P	Nil

IKGPTU HUSS Courses/Curricular Structure

Semester	L-T-P-C	Course No. & Title
1	2-1-0-3	L-101 Basic English
3	2-1-0-3	HSMC-103/HSMC-104 Foundation Course in Humanities (Development of Societies/Philosophy)
4	2-1-0-3	HSMC122-18 Universal Human Values – 2: Understanding Harmony
5-8	2-1-0-3	Humanities & Social Sciences Management Electives

List of Humanities & Social Sciences Including Management

Sr. No.	Course Code	Course Title	Hours	Credits
1.	HSMC101-18 /HSMC102-18	Foundational Course in Humanities (Development of Societies/Philosophy)	2L:10T:0P	3
2.	HSMC103-18	Education, Technology and Society	2L:10T:0P	3
3.	HSMC104-18	History of Science and Technology in India	2L:10T:0P	3
4.	HSMC105-18	Nyaya Logic Epistemology	2L:10T:0P	3

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5.	HSMC106-18	Political and Economic Thought for a Humane Society	2L:10T:0P	3
6.	HSMC107-18	State, Nation Building and Politics in India	2L:10T:0P	3
7.	HSMC108-18	Psychological Process	2L:10T:0P	3
8.	HSMC109-18	Positive Psychology	2L:10T:0P	3
9.	HSMC110-18	Application of Psychology	2L:10T:0P	3
10.	HSMC111-18	Sociology, Society and Culture	2L:10T:0P	3
11.	HSMC112-18	Epochal Shift	2L:10T:0P	3
12.	HSMC113-18	Values and Ethics	2L:10T:0P	3
13.	HSMC114-18	Ethics and Holistic Life	2L:10T:0P	3
14.	HSMC115-18	Folk and Vernacular Expressive Tradition and Popular Culture	2L:10T:0P	3
15.	HSMC116-18	Universal Human Conduct	2L:10T:0P	3
16.	HSMC117-18	Gender Culture and Development	2L:10T:0P	3
17.	HSMC118-18	Introduction to Women's and Gender Studies	2L:10T:0P	3
18.	HSMC118-18	Introduction to Women's and Gender Studies	2L:10T:0P	3
19.	HSMC119-18	Advance Course in Peace Research	2L:10T:0P	3
20.	HSMC120-18	Contemporary India in Globalized Era: Challenges of Democracy and Development	2L:10T:0P	3
21.	HSMC121-18	Making Indian Culture: Epistemic Traditions, Literature and Per formative Arts	2L:10T:0P	3
22.	HSMC122-18	Universal Human Values 2: Understanding Harmony	2L:10T:0P	3
23.	HSMC123-18	Human relations at work	2L:10T:0P	3
24.	HSMC124-18	Sanskrit Bhasa	2L:10T:0P	3
25.	HSMC125-18	Language and Communication	2L:10T:0P	3
26.	HSMC126-18	Language and Linguistics	2L:10T:0P	3
27.	HSMC127-18	Understanding Society and Culture through Literature	2L:10T:0P	3
28.	HSMC128-18	Fundamentals of Linguistics	2L:10T:0P	3
29.	HSMC128-18	Fundamentals of Linguistics	2L:10T:0P	3
30.	HSMC129-18	Elements of Literature	2L:10T:0P	3
31.	HSMC130-18	Humanities and Multiple Dimensions of Ecology	2L:10T:0P	3
32.	HSMC131-18	Film Appreciation	2L:10T:0P	3
33.	HSMC(MIM-472)	Introduction to Industrial Management	2L:10T:0P	3
34.	HSMC (MIM-480)	Macro Economics	2L:10T:0P	3
35.	HSMC (MIM-578)	Quantitative Methods for Decision Making	2L:10T:0P	3
36.	HSMC (MIM-475)	Economics for Engineers	2L:10T:0P	3
37.	HSMC (MME-301)	Fundamentals of Management for Engineers	2L:10T:0P	3
38.	HSMC (MME-302)	Project Management and Entrepreneurship	2L:10T:0P	3
39.	HSMC (MME-303)	Law and Engineering	2L:10T:0P	3
40.	HSMC (MME-304)	Understanding Interpersonal Dynamics	2L:10T:0P	3

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THIRD SEMESTER

B.Tech.

Electronics & Communication Engineering

Syllabus

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Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

BTEC-301-18	Credits	L	T	P	Int	Ext
Electronic Devices	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to recall concepts of semiconductor physics and understand the behaviour and working of semiconductor devices using mathematical models.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand physics of semiconductors and behavior of charge carriers within semiconductors
2. Understand the working of semiconductor diodes supported with mathematical explanation.
3. Understand the working of BJT and MOSFET with their equivalent small signal models.
4. Understand the chemical processes used in fabrication of integrated circuits.

Unit 1: Semiconductor Physics

Review of quantum mechanics; electrons in periodic lattices; e-k diagrams; energy bands in intrinsic and extrinsic silicon; diffusion current; drift current; mobility and resistivity; sheet resistance; design of resistors.

Unit 2: Diodes

Generation and recombination of carriers; Poisson and continuity equation p-n junction characteristics; V-I characteristics; small signal switching models; avalanche breakdown; Zener diode; Schottky diode; light emitting diode; tunnel diode; varactor diode, solar cell, Rectifier & Regulator circuits.

Unit 3: Transistors

Bipolar junction transistor; V-I characteristics; Ebers-Moll model; Transistor Configurations - CE, CB, CC; MOS capacitor; MOSFET - Construction and Working; I-V characteristics; Depletion-type and Enhancement-type MOS.

Unit 4: Fabrication Processes

Oxidation; diffusion; ion-implantation; Annealing; photolithography; etching; chemical vapour deposition (CVD); sputtering; twin-tub CMOS process.

Recommended Books

1. G. Streetman, and S. K. Banerjee, *Solid State Electronic Devices*, Pearson.
2. D. Neamen, D. Biswas, *Semiconductor Physics and Devices*, McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, *Physics of Semiconductor Devices*, John Wiley & Sons
4. C. T. Sah, *Fundamentals of solid state electronics*, World Scientific Publishing Co. Inc.

BTEC-302-18	Credits	L	T	P	Int	Ext
Digital System Design	3	3	0	0	40	60

Course Objective

This is course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Apply concepts of Boolean algebra for handling logical expressions.
2. Understand working and realization of combinational circuits.
3. Understand working flip-flops and use them in designing of sequential circuits.
4. Understand fundamental concepts of logic families and architectural of programmable devices.
5. Use HDL programming tool for simulation of combinational & sequential circuits.

Unit 1: Boolean Algebra & Combinational Circuits

Logic gates; Boolean algebra; De Morgan's theorem, SOP & POS forms, canonical forms, Karnaugh maps up to 6 variables, binary codes, code Conversion, MSI devices like comparators; multiplexers; encoder; decoder; driver & multiplexed display; half and full adders; subtractors; serial and parallel adders; BCD adder; barrel shifter and ALU.

Unit 2: Sequential Circuits

Building blocks of sequential circuits like S-R, J-K,T & D flip-flops; master-slave J-K FF; edge triggered FF; ripple counters; synchronous counters; shift registers; finite state machines; design of synchronous FSM, algorithmic state machines charts; designing synchronous circuits like pulse train generator; pseudo random binary sequence generator; clock generation.

Unit 3: Programmable Devices & ADC and DAC

Specifications: noise margin, propagation delay, fan-in, fan-out, Tristate; TTL, ECL, CMOS families and their interfacing; architectures of PLA, PAL, GAL, CPLD&FPGA. DAC: weighted resistor, R-2R ladder, resistor string; ADC: single slope, dual slope, successive approximation, flash.

Unit 4: Introduction to VHDL

VHDL constructs; Data types and objects; different modelling styles in VHDL; Dataflow, Behavioural and Structural Modelling; Synthesis and Simulation; HDL programming for basic combinational and sequential circuits.

Recommended Books

1. R.P. Jain, *Modern digital Electronics*, Tata McGraw Hill
2. Douglas Perry, *VHDL*, Tata McGraw Hill
3. W.H. Gothmann, *Digital Electronics-An introduction to theory and practice*, PHI
4. D.V. Hall, *Digital Circuits and Systems*, Tata McGraw Hill
5. Charles Roth, *Digital System Design using VHDL*, Tata McGraw Hill

BTEC-303-18	Credits	L	T	P	Int	Ext
Electromagnetic Waves	3	3	1	0	40	60

Course Objective

This course deals with knowledge and background required for better understanding of Electromagnetic Waves and fundamentals.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand characteristics & wave propagation through transmission lines
2. Understand Maxwell's equations for electromagnetic waves
3. Characterize uniform plane wave
4. Calculate reflection and transmission of waves at media interface

Unit 1: Transmission Lines

Equations of voltage and current on transmission line; propagation constant and characteristic impedance, and reflection coefficient and VSWR; Loss-less and Low-loss transmission line; Power transfer on transmission line; S-parameters, Smith chart; applications of transmission lines; impedance matching; use of transmission line sections as circuit elements.

Unit 2: Maxwell's Equations

Basics of vectors; Vector calculus; Basic laws of Electromagnetic; Maxwell's equations; Boundary conditions at media Interface.

Unit 3: Uniform Plane Wave

Uniform plane wave; propagation of wave; wave polarization; Poincare's sphere; wave propagation in conducting medium; phase and group velocity; power flow and Poynting vector; surface current and power loss in a conductor.

Unit 4: Plane Waves at a Media Interface

Plane wave in arbitrary direction; reflection and refraction at dielectric interface; total internal reflection; wave polarization at media interface; reflection from a conducting boundary.

Unit 5: Wave propagation in parallel plane waveguide

Analysis of waveguide general approach; rectangular waveguide, modal propagation in rectangular waveguide; surface currents on the waveguide walls, field visualization, attenuation in waveguide.

Recommended Books

1. RK Shevgaonkar, *Electromagnetic Waves*, Tata McGraw Hill India
2. EC Jordan & KG Balmain, *Electromagnetic waves & Radiating Systems*, PHI
3. N Rao,*Engineering Electromagnetics*, Prentice Hall
4. DCheng, *Electromagnetics*. Prentice Hall
5. W H Hayt & J A Buck,*Engineering Electromagnetics*, McGraw Hill

BTEC-304-18	Credits	L	T	P	Int	Ext
Network Theory	3	3	1	0	40	60

Course Objective

This course is meant to create mathematical foundation which can further be extrapolated to understand and analyze the electrical networks.

Course Outcomes

At the end of this course student will be able to:

1. Analyze linear networks using network theorems.
2. Use Laplace transform to analyze transient & steady state response of linear networks.
3. Comprehend network parameters to analyze two port networks.
4. Realize one port networks using Foster's and Cauer's methods.

Unit 1: Network Theorems

Node and mesh analysis; impedance matrix approach for networks analysis; Network theorems: superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC circuits; Trigonometric and Exponential Fourier series, Fourier Transform and continuous spectra Three phase unbalanced circuit and power calculation.

Unit 2: Transient & Steady State Analysis

Transient behavior, concept of complex frequency, Driving points, Poles and Zeros, Laplace transforms and properties: singularity functions, waveform synthesis; time domain analysis of RC, RL & RLC networks with and without initial conditions; Laplace Transforms for steady state and transient response of networks, quality factor.

Unit 3: Two Port Networks

Impedance parameters; admittance parameters; transmission parameters; hybrid parameters; inter-relationships between two port network parameters; interconnection of two port networks; T and Pi representation of two port networks; image impedance; characteristic impedance; propagation constant; filters: low pass, high pass; band pass, band stop & Butterworth filter.

Unit 4: Network Synthesis

Realizability criteria: Hurwitz polynomial, positive real functions; network realization using Foster's first and second forms; network synthesis using Cauer's first and second forms.

Recommended Books

1. Van, Valkenburg, *Network Analysis*, PHI
2. F F Kuo, *Network Analysis & Synthesis*, Wiley
3. A. Sudhakar, SP Shyammohan, *Circuits and Network*, Tata McGraw-Hill
4. A William Hayt, *Engineering Circuit Analysis*, McGraw-Hill Education

BTAM-303-18	Credits	L	T	P	Int	Ext
Mathematics III	4	3	1	0	40	60

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables along with Probability and Correlation. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

The students will learn:
1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
5. To provide an overview of probability and statistics to engineers

Section A

Unit 1 : Transforms Calculus-I:

Laplace Transform, Properties of Laplace Transform, Laplace Transform of Unit step function, Impulse function, Dirac-delta function, Periodic functions. Inverse Laplace Transform, convolution theorem, Evaluation of integrals by Laplace Transform, Applications to ODEs and PDEs.

Unit 2: Transforms Calculus-II:

Fourier Series, half range Fourier Sine and Cosine series, Fourier integrals, Gibbs Phenomenon, Fourier transforms, Relation between Laplace and Fourier transform, Properties of Fourier Transforms, Convolution Theorem and applications

Unit 3: Transforms Calculus-III

Basic theory of Z transforms, Translation theorem, Scaling property of Z transforms, Initial and Final value theorems, Differentiation of Z tranforms Solution of Difference equations using Z transform, Applications of Z transforms to find the sum of series

Section B

Unit 4: Probability

Conditional probability, Discrete and continuous random variables, Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distributions.

Unit 5: Correlation and regression

Correlation and Regression for bivariate data, Rank correlation, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance for small and large samples (z-test, t-test, F-test and Chi-square test).

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Text / References:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. R K jain and Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publishing, 2017.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
5. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.

BTEC-311-18	Credits	L	T	P	Int	Ext
Electronic Devices Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of semiconductor devices and making them to use in circuits & projects.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize use of diodes in circuits with proper understanding to their working.
2. Understand characteristics & working of BJT in different configurations.
3. Understand characteristics & working of MOSFET in circuits.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments

1. To Study of datasheets of semiconductor devices.
2. To study the V-I characteristics of PN junction diode.
3. To study a Zener diode as voltage regulator.
4. To study the output waveform of a Half-wave rectifier.
5. To study the functioning of a Diode as a switch.
6. To study the output waveform of a Full-wave center-tapped and bridge rectifier.
7. To study Input & output V-I characteristics of npn/pnp BJT in CE configuration
8. To study Input & output V-I characteristics of npn/pnp BJT in CB configuration
9. To study the functioning of a BJT as a switch.
10. To study V-I Characteristics of a MOSFET.

Part-B: Lab Projects

Every individual student is required design and build one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Blinking linear/circular lights
2. Ambient light sensor based controller
3. Regulated dual power supply of ±5V or ±12V or mixed
4. BJT audio amplifier
5. BJT circuit for sampling of analog signal

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6. Simulate any project idea using SPICE software

BTEC-312-18	Credits	L	T	P	Int	Ext
Digital System Design Lab	1	0	0	2	30	20

Course Objective

This is laboratory course meant to realize basic digital circuits using physical components and EDA tools in simulation environment.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize combinational circuits using logic gates.
2. Realize sequential circuits using logic gates.
3. Write & simulate VHDL programs for combinational & sequential circuits.
4. Think and design working projects using digital 74XX ICs.

Part-A: Experiments (Any 10 Experiments)

1. To verify the Truth-tables of all logic gates.
2. To realize and verify the Half & full adder circuits using logic gates.
3. To realize Half & full subtractor circuits using logic gates.
4. To realize 4-bit binary-gray & gray-binary converters.
5. To realize comparator circuit for two binary numbers of 2-bit each.
6. To realize Full adder & full subtractor circuits using 8x3 encoder.
7. To design Full adder & full subtractor circuits using 8x3 demultiplexer.
8. To design and verify the Truth tables of all flip-flops.
9. To design Mod-6/Mod-9 synchronous up-down counter.
10. To write VHDL program for combinational & sequential circuits from S. No. 2 to 7
11. To write VHDL program for universal shift-register operations

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Pulse Width Modulator based LED dimmer using 555 timer IC.
2. Up-down 4-bit counter with seven-segment display.
3. Construction of combinational circuits using universal gates.
4. Bi-directional visitors counter
5. Traffic light control system
6. Any project based on Arduino platform

HSMC 101-18/HSMC 102-18	Credits	L	T	P	Int	Ext
Foundational Course in Humanities (Development of Societies or Philosophy)	3	3	0	0	40	60

The syllabus is same as in HUSS subjects given by AICTE Model Curriculu

BTEI-321-18	Credits	L	T	P	Int	Ext
4-Week Institutional Training	0	0	0	4	60	40

Four weeks training in the area of Electronics and Communication Engineering. This training should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her.

BMPD-331-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development
The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record of students for each activity conducted and the same shall be submitted to the department.

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FOURTH SEMESTER

B.Tech.

Electronics & Communication Engineering

Syllabus

IKGujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

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BTEC-401-18	Credits	L	T	P	Int	Ext
Analog Circuits	4	3	1	0	40	60

Course Objective

This course deals design & analytical concepts of various Analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will be able to:

1. Understand the biasing of transistors and analyze BJT/FET amplifiers
2. Analyze various rectifier and amplifier circuits
3. Analyze sinusoidal and non-sinusoidal oscillators
4. Understand various types of Power Amplifiers

Unit 1: Diode and Transistor Amplifier Circuits

Diode Circuits, Amplifiers types: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier, biasing schemes for BJT and FET amplifiers; bias stability; transistor configurations: CE/CS, CB/CG, CC/CD and their features; small-signal analysis; low-frequency transistor models; amplifier analysis: current gain, voltage gain, input resistance and output resistance; amplifier design procedure; low frequency analysis of multistage amplifiers. High frequency transistor models.

Unit 2: Feedback Amplifiers

Feedback topologies: Voltage series, current series, voltage shunt and current shunt feedback; effect of feedback on gain, bandwidth, input & output impedances; concept of stability, gain margin and phase margin.

Unit 3: Oscillators Introduction, Types of Oscillators, Barkhausen criterion, RC-phase shift, Wien bridge, Hartley, Colpitts, Clapp oscillators and Non-sinusoidal oscillators.

Unit 4: Power Amplifiers

Class A, B, AB and C power amplifiers, their efficiency and distortions; frequency response: single stage, multistage amplifiers and cascade amplifier.

Recommended Books

1. J Millman & A Grabel, *Microelectronics*, McGraw Hill
2. J Millman& C Halkias, *Integrated Electronics*, Tata McGraw Hill
3. A Ramakant, Gayakwad, *Op-Amps And Linear Integrated Circuits*, PHI
4. P Horowitz & W Hill, *The Art of Electronics*, Cambridge University Press
5. AS Sedra & KC Smith, *Microelectronic Circuits*, Saunder's College Publishing

BTEC-402-18	Credits	L	T	P	Int	Ext.

Microprocessors and Microcontrollers	3	3	0	0	40	60

Course Objective

This is course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand architecture &functionalities of different building block of 8085 microprocessor.
2. Understand working of different building blocks of 8051 microcontroller.
3. Comprehend and apply programming aspects of 8051 microcontroller.
4. Interface & interact with different peripherals and devices.

Unit 1: Microprocessor 8085

History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; programming techniques, counters and time delays; stack and subroutines; interrupts.

Unit 2: Microcontroller 8051 - Building Blocks

Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

Unit 3: Microcontroller 8051 - Programming

Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

Unit 4: Microcontroller 8051 - Interfacing

Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

Recommended Books

1. R S Gaonkar, *Microprocessor Architecture, Programming and Application with 8085*, Penram International Publishing Pvt. Ltd.
2. Kenneth Ayala, *The 8051 Microcontroller*, Cengage Learning
3. Douglas Hall, *Microprocessors Interfacing*, Tata McGraw Hill
4. Subrata Ghoshal, *8051 Microcontroller: Internals, Instructions, Programming and Interfacing*, Pearson Education
5. K Uma Rao, Andhe Pallavi, *The 8051 Microcontrollers: Architecture, Programming and Applications*, Pearson Education.

BTCS-301-18	Credits	L	T	P	Int	Ext
Data Structures and Algorithms	3	3	0	0	40	60

Finalized by the concerned Board of Studies of Department of Computer Science and Engineering.

Course Objectives: The objective of the course is to impart the basic concepts of data structures and algorithms, to understand concepts about searching and sorting technique and to understand basic concepts about stacks, queues, lists, trees and graphs, data structures.

Course outcomes

Student will be able to:

1. Understand operations like searching, insertion, deletion, traversing on linear Data Structures and to determine their computational complexities
2. Understand operations like searching, insertion, deletion, traversing on various non linear Data Structures and to determine their computational complexities
3. Write algorithms for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
4. Apply appropriate Data Structure as per specific problem definition

Detailed contents: Module 1:

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Introduction to pointers and dynamic memory allocation, use of pointers in self referential data structures.

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. 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.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis, Applications of Binary Trees.

Module 4:

Sorting and Hashing: 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.

Suggested books:

1. "Classic Data Stuructures", Samanta and Debasis, PHI publishers
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
3. "Data Structures with C (Schaum's Outline Series)",Seymour Lipschutz,Mc Graw Hill.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer" , 2nd Impression by R. G. Dromey, Pearson Education.
3. Algorithms by Tannenbaum

BTEC-403-18	Credits	L	T	P	Int	Ext
Signals & Systems	4	3	1	0	40	60

Course Objective: The objective of this course is to enable students to apply mathematical concepts and tool in analysis of electrical signals and systems.

Course outcomes:

At the end of this course students will demonstrate the ability to:

1. Mathematically characterize different types of signals and systems.
2. Analyze the behavior of linear-shift invariant systems.
3. Apply concepts of Fourier and Laplace Transforms to analyze continuous-time signals and systems.
4. Investigate discrete-time signals and systems using Discrete-Time Fourier and Z-Transforms and simple Probability concepts.

Unit 1: Introduction to Signals and Systems

Classification of Signals: Periodic and Aperiodic signals, continuous and discrete time signals, continuous and discrete amplitude signals; Linear and nonlinear signals, Causal and non-causal signals, Even and odd signals, Energy and power signals; System properties: linearity, shift-invariance ,causality, stability, Realizability.

Unit 2: Linear-Shift Invariant Systems

Linear shift-invariant systems; Impulse response and step response ;Convolution, Input-output behaviour with Aperiodic convergent inputs; Characterization of causality and stability of LSI systems; System representation through differential equations and difference equations; Periodic inputs to an LSI system; Notion of frequency response and its relation to the impulse response.

Unit 3: Continuous-Time Analysis of Signals and Systems

Fourier Series; Fourier Transform; Magnitude and phase response; Properties of Fourier Transform: Convolution/Multiplication, Duality, Time-shifting, Frequency-shifting, Time-scaling, Integration and differentiation in time-domain; Review of Laplace Transform for continuous-time signals and systems; Notion of Eigen functions of LSI systems; System transfer function and poles-zeros analysis; Solution to differential equations and system behaviour.

Unit 4: Discrete-Time Analysis of Signals and Systems

Sampling Theorem and its proof. Spectra of sampled signals; Aliasing and its effects; Reconstruction and its implications; Probability: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions. Discrete-Time Fourier Transform (DTFT); Discrete Fourier Transform; Parseval's Theorem; Review of Z-Transform for discrete-time signals and systems; System functions; Region of convergence and z-domain analysis, Conditional Probability.

Text/Reference books:

1. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, *Signals and Systems*, Pearson Education
2. I J Nagrath, S N Sharan. R Ranjan S Kumar, *Signals and Systems*, Tata McGraw Hill
3. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press
4. S Poornachandra, B Sasikala, *Signals and Systems*, Tata McGraw Hill
5. Robert A. Gabel, Richard A. Roberts, *Signals and Linear Systems*, John Wiley and Sons.

HSMC 122-18	Credits	L	T	P	Int	Ext
Universal Human Values-2 : Understanding Harmony	3	3	0	0	40	60

The syllabus of this course is same as given in detailed HUSS group syllabus in AICTE Model Curriculum 2018.

EVS-101-18	Credits	L	T	P	Int	Total
Mandatory Course: Environmental Sciences	Non-credit	2	0	0	50	50

Finalized by the Board of Studies of Department of Civil Engineering.

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

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3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

1. Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1 : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

Module 2 : Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.
Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem

b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
-

Module 4 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rahabilitation of people; its problems and concerns.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion,

  Nuclear accidents and holocaust. Case Studies.
- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems

1*(A) Awareness Activities:*

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts

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f) Plantation

g) Gifting a tree to see its full growth

h) Cleanliness drive

h) Drive for segregation of waste

i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess

j) To know about the different varieties of plants

k) Shutting down the fans and ACs of the campus for an hour or so

l) Visit to a local area to document environmental assets

river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural

n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H &Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

BTEC-411-18	Credits	L	T	P	Int	Ext
Analog Circuits Lab	1	0	0	2	30	20

Course Objective

This laboratory course deals design & analytical concepts of various analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study and verify the characteristics of diodes/BJTs in circuits with proper understanding to their working.
2. Understand frequency response & working of various types of Oscillators.
3. Understand characteristics & working of Power amplifiers.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments:

1.To Study the Output waveforms of diode clipper and Diode Clamper circuits.
2.To study BJT amplifier in CE configuration.
3. To study V-I Characteristics of FET/MOSFET.
3.To study Emitter follower circuit.
4. To calculate the frequency and observe the output waveform of RC phase shift oscillator.
5.To measure the frequency and observe the output waveform of Wein bridge oscillator.
6. To measure the frequency and observe the output waveform of Hartley oscillator.
7. To measure the frequency and observe the output waveform of Colpitt's oscillator.
8. To study Output waveform of Class-A Power Amplifier.
9. To study Output waveform of Class-B Power Amplifier.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. BJT audio amplifier/power amplifier
2. Any project based on IoT/Arduino platform

BTEC-412-18	Credits	L	T	P	Int	Ext
Microprocessors and Microcontrollers Lab	1	0	0	2	30	20

Course Objective

This is laboratory course meant to write programs using 8085/8086 microprocessor and learn interfacing using 8051 microcontoller for general operations.

Course Outcomes

At the end of this Lab course student will be able to:

1. Write programs for common arithmetic operations with 8-bit/16-bit numbers using 8085.
2. Write programs for transfer, sort block of data with 8085/8086 processor(s).
3. Write programs for controlling stepper and DC motors using Microprocessor(s).
4. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller.

Part-A: Write programs in Assembly language & embedded C to

1. Add two 8-bit numbers stored in registers or internal/External memory locations.
2. Multiply two 8-bit numbers.
3. Multiply two 16-bit numbers.
4. Transfer block of data from internal memory locations to external memory locations
5. Sort block of data in ascending or descending order.
6. Generate 5KHz pulse waveform of 50% duty cycle.
7. Interface ADC and DAC.
8. Interface Matrix Keyboard.
9. Interface LCD Displays.
10. Interface Stepper Motor.
11. Control DC motor using PWM.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. RFID attendance system
2. Home automation
3. Robotic vehicle
4. Sensor traffic lights
5. Floor cleaning robot
6. Robot for defense applications
7. GPS vehicle tracking
8. Accident identification and SMS

BMPD-341-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)

5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted
and the same shall be submitted to the department.

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FIFTH SEMESTER

B.Tech.

Electronics & Communication Engineering

Syllabus

IKGujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

Head
Department of Electronics & Communication Engineering
IK Gujral Punjab Technical University
Main Campus, Kapurthala (Punjab)-144603

BTEC-501-18	Credits	L	T	P	Int	Ext
Analog and Digital Communication	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Analog as well as Digital Communication and understand the working of common communication techniques.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB,Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals, Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De emphasis.

Unit 2:Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 3: Elements of Detection Theory

Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'',John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

BTEC-502-18	Credits	L	T	P	Int	Ext
Digital Signal Processing	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Digital Signal Processing and understand the commonly used digital filters and systems.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

Unit 1: Discrete Time Signals

Elementary Discrete time sequences and systems; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. Implementation of Discrete Time Systems, Linear Periodic and Circular convolution, Z-Transform, Inverse Z-Transform methods, Properties of Z-Transform.

Unit 2: LSI Systems

Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) with their properties, Inverse DFT and FFT methods, Goertzel Algorithm.

Unit 3: Digital filters Design

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Time Invariant and Bilinear Transformation Methods,Rectangular,Hamming and Hanning Window methods, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects: Fixed point and Floating point representations, Effect of round off noise in digital filters, Limit cycles.

Unit 4: Introduction to Multirate signal processing and DSP processors

Concepts of Multirate Signal Processing, need and significance, Applications of DSP,Limitations of Analog signal processing, Advantages of Digital signalprocessing, Architectures of ADSP and TMS (C6XXX) series of processor.

Recommended Books

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH, 2001.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.

6. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTEC-503-18	Credits	L	T	P	Int	Ext
Linear Integrated Circuits	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Linear Integrated Circuits and their working along with their applications.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand Differential and Cascade Amplifiers
2. Know the basics, working and characteristics of Op-Amps
3. Investigate various applications of Op-amps
4. Understand some specialized Op-Amps
5. Interpretation of Data Sheets and their Applications thereof.

UNIT I: DIFFERENTIAL ANDCASCADE AMPLIFIERS

Introduction: Differential Amplifier, its Circuit Configuration, Dual Input-Balanced output Differential amplifier, Dual Input Unbalanced output, Single Input Balanced & Unbalanced Output Differential Amplifier, Amplifier with their DC and AC analysis, Differential Amplifier with Swaping resistors, Constant current bias, Current Mirror, Cascaded differential amplifier stages, Level Translator, CE-CB Configuration.

UNIT II: INTRODUCTION TO OPERATIONAL AMPLIFIERS

Block diagram of a typicalOp-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of Data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio. Feedback configurations.

UNIT III: APLICATIONS OF OP-AMP

DC and AC amplifiers, Peaking Amp, Summing,Scaling and Averaging Amp, Instrumentation Amplifier, Log and Antilog Amp, Integrator, Differentiator. Active filters: First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second-order HP Butterworth filter, Higher order filters, Band Pass filter, Band reject Filter, All Pass filter, Phase shift Oscillator, Wein Bridge Oscillator, Square wave Oscillator, Basic Comparator, Schmitt trigger, V to F and F to V converters.

UNIT IV: SPECIALIZED IC APPLICATIONS

IC 555 Timer: Pin configuration, Blockdiagram, application of IC 555 as Monostable and AstableMultivibrator., Phase Lock Loops: Operating principles & applications of IC 565 and IC 566,Monolithic PLL TL082, Voltage Regulators: Fixed voltage regulators (78XX and 79XX), Adjustable voltage regulators (LM327), Analog multiplier ICs (MPY634 KP) and their applications, Switching Regulators, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

Recommended Books

1. 1. Op Amps & Linear Integrated circuits by Ramakant A. Gayakwad, Pearson
2. Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Prentice Hall
3. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH

BTEC-504-18	Credits	L	T	P	Int	Ext
Control Systems	4	3	1	0	40	60

Course Objective

This is the course meant to gain the knowledge ofimportant control systems, characterize them and study their state behaviour.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Characterize a system and find its study state behaviour
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve linear, non-linear and optimal control problems

Unit 1: Introduction

Classification with understanding of Industrial Control system examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, DC and AC servomotors, Tacho generators, Electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback Control systems

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3: Second Order systems

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation. Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

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Unit 4: State variable Analysis

Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, tracking problem. Nonlinear system – Basic concept & analysis.

Recommended Books:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., " Modern Control Engineering" , Prentice Hall, second edition, 1991.
4. Nagrath& Gopal, "Modern Control Engineering", New Age International, New Delhi.

Professional Electives of ICT Group (Elective-1)

BTEC-905A-18	Credits	L	T	P	Int	Ext
Routing and Switching	3	3	0	0	40	60

Course Outcomes

- Demonstrate a basic understanding of small and medium-sized networks, including general network technologies.
- Ability to assist the design of small and medium-sized networks, and implement the designs.
- Ability to construct simple networks and integrate voice, wireless, cloud, security, and storage technologies into their networks in order to support a variety of applications.

Network Fundamentals

Basics of network architecture, enterprise network constructs, Ethernet framing, IP addressing, Internet Control Message Protocol, Address Resolution Protocol, Transport Layer Protocols, Data Forwarding Scenario. Expanding the Enterprise Network, Navigating the CLI, File System Navigation and Management, VRP Operating System Image Management.

Network Connections

Establishing a Single Switched Network, Spanning Tree Protocol, Rapid Spanning Tree Protocol, Segmenting the IP Network, IP Static Routes, Distance Vector Routing with RIP, Link State Routing with OSPF, DHCP, FTP and Telnet Protocols, Simple Network Management Protocol, Introducing IPv6 Networks, IPv6 Routing Technologies, IPv6 Application Services

Network Construction

Link Aggregation, VLAN Principles, GARP and GVRP, VLAN Routing, Wireless LAN Overview, Bridging Enterprise Networks with Serial WAN Technology, Frame Relay Principles, Establishing DSL/ADSL Networks with PPPoE, Network Address Translation, Establishing Enterprise Radio Access Network Solutions.

Network Security

Access Control Lists, Authentication, Authorization and Accounting (AAA), Securing Data with IPsec and VPN, Generic Routing Encapsulation.

Recommended Books:

1. Computer Networks by Andrew S. Tanenbaum, David J. Wetherall, Pearson
2. https://ilearningx.huawei.com/portal/#/courses/course-v1:HuaweiX+EBGTC00000030+2018.7/about

BTEC-905B-18	Credits	L	T	P	Int	Ext
Random Variables and Stochastic Processes	3	3	0	0	40	60

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function,example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

Joint distributions, functions of one and two random variables, moments of randomvariables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;

Random sequences and modes of convergence (everywhere, almost everywhere,probability, distribution and mean square). Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density

Text/Reference Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.

5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

BTEC-905C-18	Credits	L	T	P	*Int	Ext
VLSI/ULSI Technology	3	3	0	0	40	60

Course Objectives: To study various VLSI fabrication steps such as oxidation, lithography, etc.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. understand the process of VLSI fabrication
2. Investigate the Oxidation processes for VLSI/ULSI device fabrication
3. Learn about the environment for VLSI/ULSI technology
4. Understand Lithography and deposition processes

VLSI Fabrication : Solid state diffusion modeling and technology, ion implantation technology and damage annealing, characterization of impurity profiles.

Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films. Oxidation techniques in VLSI and ULSI, characterization of oxides films, low k and high k dielectrics for ULSI.

Environment for VLSI/ULSI Technology, Clean room and safety requirements, Wafer cleaning process and wet chemical etching techniques.

Lithography: Photolithography, e-beam lithography and newer lithography techniques for VLSI/ ULSI, mask generation. chemical vapor deposition techniques : CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitrite and metal films, epitaxial growth of silicon.
Metal film deposition: Evaporation and sputtering techniques, failure mechanisms in metal interconnect multilevel metallization schemes.

Plasma and rapid thermal processing, PECVD, plasma etching and RIE techniques, RTP techniques for annealing, growth and deposition of various films for use in ULSI

TEXT/Reference BOOKS

1. VLSI Technology, S. M. Sze, McGraw Hill, II , 1988 REFERENCE BOOKS
2. VLSI fabrication principles, S. K. Gandhi, "John Wiley, New York",1983
3. ULSI Technology, C. Y. Chang. S. M. Sze, McGraw Hill companies,1996

BTEC-905D-18	Credits	L	T	P	*Int	Ext
Programming in JAVA	3	3	0	0	40	60

Course Outcomes:

After this course the students will be able to:

1. Apply the concepts and basics of JAVA
2. Demonstrate the knowledge of operators and control statements
3. Ability to learn about Inheritance, Interface, Applets.
4. Learn about JAVA database connectivity

Introduction to Java: History of Java, Features of Java, Java Development Kit (JDK), Security in Java, Java Basics: Keywords; Working of Java; Including Comments; Data

Types in Java; Primitive Data Types; Abstract / Derived Data Types; Variables in Java; Using Classes in Java; Declaring Methods in Java, Code to Display Test Value; The main() Method, Invoking a Method in Java; Saving, Compiling and Executing Java Programs

Operators and Control Statements: Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators, Logical Operators, Operator Precedence; Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do...While Loop, Break Statement Continue Statement
Arrays and Strings: Arrays; String Handling; Special String Operations; Character Extraction; String Comparison; Searching Strings; String Modification; StringBuffer

Inheritance, Package and Interface: Inheritance, Types of Relationships, What is Inheritance?, Significance of Generalization, Inheritance in Java, Access Specifiers, The Abstract Class; Packages, Defining a Package, CLASSPATH; Interface, Defining an Interface, Some Uses of Interfaces, Interfaces versus Abstract Classes Exception Handling: Definition of an Exception; Exception Classes; Common Exceptions; Exception Handling Techniques, Streams in Java: Streams Basics; The Abstract Streams; Stream Classes; Readers and Writers; Random Access Files; Serialization

Applets: What are Applets?; The Applet Class; The Applet and HTML; Life Cycle of an Applet; The Graphics Class; Painting the Applet; User Interfaces for Applet; Adding Components to user interface; AWT (Abstract Windowing Toolkit) Control,Event Handling: Components of an Event; Event Classes; Event Listener; Event-Handling; Adapter Classes; Inner Classes; Anonymous Classes, Swing: Concepts of Swing; Java Foundation Class (JFC); Swing Packages and Classes; Working with Swing- An Example; Swing Components

Java Data Base Connectivity: Java Data Base Connectivity; Database Management; Mechanism for connecting to a back end database; Loading the ODBC driver, RMI, CORBA and Java Beans: Remote Method Invocation (RMI); RMI Terminology; Common Object Request Broker Architecture (CORBA), What is Java IDL?, Example: The Hello Client-Server; Java Beans, The BeanBox, Running the BeanBox.

BTEC-905E-18	Credits	L	T	P	Int	Ext
Speech and Audio Processing	3	3	0	0	40	60

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Mathematically model the speech signal
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP. Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.

2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

BTEC-505-18	Credits	L	T	P	Int	Ext
Project Management	3	3	0	0	40	60

Course Objective: To acquaint the students with the steps involved in the planning, implementation, scheduling and control of projects.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study the basic concepts of Project Management.
2. learn about Project selection and organisation.
3. understand Project planning and scheduling.
4. learn about Project Monitoring, control and performance.

UNIT - I: Project Management Concepts Attributes of a Project, Project Life Cycle, The Project management Process, Global Project Management, Benefits of Project Management, Needs Identification.

UNIT - II: Project Selection, Preparing a Request for Proposal, Soliciting Proposals, Project organization, the project as part of the functional organization, pure project organization, the matrix organization, mixed organizational systems.

UNIT - III: Project Planning and Scheduling: Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource allocation, Crashing and Resource Sharing.

UNIT - IV: Project Monitoring/Control and Project Performance: Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Suggested Books/References:

1. Chandra, P. (2017). Projects: Preparation, Appraisal, Budgeting and Implementation. 8th Edition,Tata Mcgraw .
2. Desai, V. (2017). Project Management and Entrepreneurship. 2nd Edition, Himalaya Publishing House.
3. Fyffe, D. S. (2001). Project Feasibility Analysis. New York: John Wiley and Sons. •
4. Ragaranjan K. (2005). Elements of project Management. 1st Edition, New Age International.

BTEC-511-18	Credits	L	T	P	Int	Ext
Analog and Digital Communication Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study and investigate the outputs of various Analog and digital modulation techniques.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study and verify the characteristics and output waveforms of AM, FM, PCM
2. study and compare noise in AM and FM systems
3. investigate the output responses of PAM, PCM, PSK, FSK, MSK.

List of Experiments:

1.To study the Characteristics/output waveform of Amplitude Modulation and demodulation techniques.

2. To Investigate and compare the outputs of SSB, DSB-SC and VSB Modulation systems.

3. To study and compare Noise Interference in AM and FM systems.

4.To study the effect of threshold in Angle modulation.

5. To study the effect of Sampling and Investigate the Output response of Pulse Amplitude Modulation.

6. To Investigate the Output response of Pulse Code Modulation.

7. To Study the output response of PSK & FSK.

8. To Study Delta modulation and demodulation technique and observe effect of slope overload.

9. To study the output response of QAM.

10. To study the output response of Continuous Phase Modulation.

11. To study the output response of Minimum Shift keying.

12. Digital link simulation: error introduction & error estimation in a digital link using MATLAB (SIMULINK)/ communication simulation packages.

BTEC-512-18	Credits	L	T	P	Int	Ext
Digital Signal Processing Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of Digital Signal Processing and its applications.

Course Outcomes

At the end of this course student will demonstrate the ability to:
1. Write programs to develop various signals.
2. Write programs to generate standard sequences.
3. Develop programs to verify convolution
4. Develop programs to design various filters.

List of Experiments:
Perform the following exercises using MATLAB

1. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences.

2. Write a program in MATLAB to generate standard sequences.

3. Write a program in MATLAB to compute power density spectrum of a sequence.

4. To develop program modules based on operation on sequences like signal Shifting, signal folding, signal addition and signal multiplication.

5. To develop program for finding magnitude and phase response of LTI system described by system function H(z).

6. To write a MATLAB programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a discrete-time causal system.

List of Lab Experiments on hardware:(using C6xxx board ;Code composer studio and Acarya app)

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7. Implementation Linear and Circular Convolution
8. To Find DFT and IDFT of given time DT Signal
9. N point FFT Algorithm implementation
10. Digital Filter Design - FIR Filter Implementation
11. Digital Filter Design - IIR Filter Implementation
12. Configuring Audio Codec of C6xxx Boards
13. Configuration of Audio Input and Output Channels (Loopback/Talkback using Acarya Application)
14. Implementation of Audio Delay Line, Echo and Audio Reverberation
15. Applications - Digital Signal Generations
16. Moving Average filter Design (Noise Cancellation using Acarya Application Reference)

BTEC-513-18	Credits	L	T	P	Int	Ext
Linear Integrated Circuits Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of the concepts of Linear Integrated Circuits.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study and investigate the configurations of Differential amplifiers.
2. measure the performance parameters of am OP-Amp.
3. use Op-Amps for various applications.

List of Experiments (Minimum 10 experiments to be performed):

1. Study differential amplifier configurations.
2. Measure the performance parameters of an Op amp.
3. Application of Op amp as Inverting and Non Inverting amplifier.
4. Study frequency response of an Op Amp and determine Gain-Bandwidth product
5. Application of Op-Amp as summing, scaling & averaging amplifier.
6. Application of Op-Amp as Instrumentation amplifier
7. Design differentiator and Integrator using Op-Amp.
8. Design Low pass, High pass and Band pass 1st order Butterworth active filters using Op-amp
9. Design Phase shift and Wein Bridge oscillator using Op-Amp.
10. Application of Op Amp as square wave, triangular wave and Sawtooth wave generator.
11. Application of Op Amp as Zero Crossing detector and window detector.
12. Application of Op Amp as Schmitt Trigger.
13. Application of 555 as Monostable and Astable multivibrator.
14. Examine the operation of a PLL and determine the free running frequency, the capture range and the lock in range of PLL.

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BTEI-521-18	Credits	L	T	P	Int	Ext
4-Week Industrial Training I	0	0	0	6	60	40

Minimum of four weeks in an Industry in the area of Electronics and Communication Engineering at the end of 4th Semester. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to the student. The outcome of the internship should be presented in the presence of the Peers and Faculty with a Power point Presentation and submit the hard copy report duly endorsed by the Industry for Evaluation to the Department. A Viva-voce will be conducted.

BMPD-351-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus
**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development
The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted
and the same shall be submitted to the department.

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SIXTH SEMESTER

B.Tech.

Electronics & Communication Engineering (ECE)

Syllabus

I K Gujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

BTEC-601-18	Credits	L	T	P	Int	Ext
Wireless Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless communication using suitable mathematical models.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the basic elements of Cellular Radio Systems and its design

2.Learn about the concepts Digital communication through fading multipath channels

3.Understand various Multiple Access techniques for Wireless communication

4.Know about the Wireless standards and systems

Unit 1: Elements of Cellular Radio Systems Design: Basic cellular system, Performance criteria, Components and Operation of cellular systems, Planning a cellular system, Analog & Digital cellular systems, Concept of frequency reuse channels, Co-channel interference, Reduction factor, desired C/I for a normal case in an omni directional antenna system, Cell splitting.

Unit 2: Digital Communication through fading multipath channels: Fading channels and their characteristics- Channel modelling, Digital signalling over a frequency non selective slowly fading channel. Concept of diversity branches and signal paths. Combining methods: Selective diversity combining, Switched combining, Maximal ratio combining, Equal gain combining.

Unit 3: Multiple Access Techniques for Wireless Communications: Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio Protocols; Pure ALOHA, Slotted ALOHA.

Unit 4: Wireless Systems & Standards: AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), IEEE Standards, Global system for Mobile (GSM): Services, Features, System Architecture and Channel Types, Frame Structure for GSM, Speech Processing in GSM, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications. CDMA Digital standard (IS 95): Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel, Wireless Cable Television.

Unit 5: Evolution of Communication Generations: Introduction to Bluetooth, Zigbee, LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

Recommended Books:

1. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

2. William C Y Lee, Mobile Cellular Telecommunications, 2nd Edition, MGH, 2004.
3. Raj Pandya, —Mobile and Personal Communication systems and services‖, Prentice Hall of India, 2001.
4. Wireless and Digital Communications; Dr. Kamilo Feher (PHI), 1998.

BTCS-504-18	Credits	L	T	P	Int	Ext
Computer Networks	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Computer networking.

Course Outcomes

At the end of this course students will demonstrate the ability to:
1.Explain the functions of the different layer of the OSI Protocol
2.Describe the function of each block of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs)
3.Develop the network programming for a given problem related TCP/IP protocol
4.Learn about DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Unit 1: Data Communication - Data Communication System & its Components, Representation of data and its flow Networks, Various Connection Topologies, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization.

Unit 2: Data Link Layer and Medium Access Sub Layer - Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP

Unit 3: Network Layer Switching - Logical addressing IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit 4: Transport Layer Process to Process Communication - User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit 5: Application Layer - Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World wide web (WWW), HTTP, SNMP, Bluetooth, Firewalls.

Recommended Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill 2007.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India 2007.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition 2013.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India 2015.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, USA 2012.

BTEC-602-18	Credits	L	T	P	Int	Ext
Optical Fibres and Communication	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the basics of Optical Communication and Optical fibres

2.Learn about the Optical Transmitters and Receivers

3.Expalin the Light wave Architecture and systems

4.Ability to explain the manufacturing, modulation and wave mixing in Optical Communication

Unit 1: Introduction

Need of Fiber Optic Communications, Evolution of Light wave Systems, Channel Multiplexing, Modulation Formats, Optical Communication Systems, Light wave System Components; Optical Fibers as a Communication Channel, Optical Transmitters, Optical Receivers.

Unit 2: Optical Fibers

Geometrical-Optics Description; Step-Index Fibers, Graded Index Fibers, Wave Propagation; Maxwell's Equations, Fiber Modes, Single-Mode-Fibers, Dispersion in Single-Mode Fibers; Group Velocity Dispersion, Material Dispersion, Wave guide Dispersion, Higher-order Dispersion, Polarization-Mode Dispersion, Dispersion-Induced Limitations; Basic Propagation Equation, Chirped Gaussian Pulses, Limitations on the Bit Rate, Fiber Bandwidth, Fiber Losses; Attenuation Coefficient, Material Absorption, Rayleigh Scattering, wave guide Imperfections, Nonlinear Optical effects; Stimulated Light Scattering, Nonlinear Phase Modulation, Four Wave Mixing, Fiber Manufacturing: Design Issues, Fabrication Methods, Cables and Connectors.

Unit 3: Optical Transmitters

Basic Concepts; Emission and Absorption Rates, p-n Junctions, Non radiative Recombination, Semi conductor Materials, Light Emitting Diodes; Power-current Characteristics, LED spectrum, Modulation Response, LED Structures, Semi Conductor Lasers; DFB Lasers, Coupled Cavity semiconductor Lasers, Tunable Semiconductor Lasers, Vertical Cavity Semiconductor Lasers, Laser Characteristics, Small & Large Signal Modulation, Spectral Line width.

Unit 4: Optical Receivers

Basic concepts, p-n Photo Diodes, p-i-n Photo Diodes, Avalanche Photo Diode, MSM Photo detector, Receiver Design, Receiver Noise; Noise mechanism, Receiver sensitivity; Bit error rate, Minimum Receiver Power, Sensitivity Degradation, Receiver Performance.

Unit 5: Light Wave Systems

Overview: System Architecture, Loss limited Light wave systems, Dispersion limited Light wave systems, Power Budget, Long Haul systems, Sources of Power Penalty; Model Noise, Dispersive Pulse Broadening, Mode Partition Noise, Frequency Chirping, Reflection Feedback Noise, WDM Light wave systems, Optical TDM Systems.

Recommended Books:

1. Senior J. Optical Fiber Communications, Principles & Practice, PHI 1985.
2. Keiser G., Optical Fiber Communication, Mc Graw-hill 2008.

3. Govind P. Agrawal, Fiber Optics Communication Systems, John Wiley & Sons (Asia) Pvt. Ltd 1998.
4. Djafar K. Mynbeav, Fiber-Optics Communications Technology, Pearson 2001.

BTEC-603-18	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering	4	3	1	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Microwave and Antenna Engineering.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1.Understand the working and operation of various Microwave Tubes and Microwave Solid-state devices.

2.Learn about various important Microwave Components and the Microwave measurements that can be carried out.

3.Explain the basic concepts and types of Antennas and its regions.

4.Describe the important concepts of Antenna Arrays and Antenna Aperture.

Unit 1: Microwave Tubes and Solid-State devices: Limitations of Conventional tubes, construction, Operation and properties of Klystron Amplifier, reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Backward Wave Oscillator (BWO), Crossed field amplifiers. Microwaves Transistors: (Bipolar, FET), Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT), Microwave Amplification by Stimulated Emission of Radiation (MASER).

Unit 2: Microwave Components and Measurements: Analysis of Microwave components using S-parameters, Junctions (E, H, Hybrid), Directional coupler, Bends and Corners, Microwave posts, S.S. tuners, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator), Cavity resonator, Matched termination. Power measurements using calorimeters and bolometers, Measurement of Standing Wave Ratio (SWR), Frequency and wavelength.

Unit 3: Antennas: Concept of radiation in Single wire, Two wire and Dipole, Introduction to Antenna parameters: Reflection Co-efficient, VSWR, Radiation pattern, Directivity, Gain. Infinitesimal dipole, Monopole and half wave dipole, Far-field, Radiating near-field and reactive near-field regions, Microstrip Patch & Fractal Antennas.

Unit 4: Antenna Arrays and Aperture Antennas: Array of two-point sources, Array factor, Array configurations, Hansen-woodyard end fire array, n-element linear array with uniform amplitude and spacing, n-element linear array with non-uniform spacing, Binomial and Dolph-Tschebysceff array. Aperture Antennas: Rectangular and circular aperture antennas, Horn antenna, Babinet's Principle, Slot Antenna, Loop antenna.

Recommended Books:

1. M.Kulkarni, Microwave and Radar Engineering, Umesh Publications, 5th Edition, 2018.
2. Jordan E.C., Electromagnetics and radiating systems, PHI 1995.
3. J.D.Krauss, Antenna Theory, McGraw Hill 1999.
4. C.A.Balanis, Antenna Theory, John Wiley & sons 4th Edition 2016.
5. R.L.Yadava, Antenna and wave propagation, PHI 2011

Professional Elective - 2

BTEC-906A-18	Credits	L	T	P	Int	Ext
WLAN and Security	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless Local Area Network (WLAN) and security.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Develop an understanding WLAN and its architecture
2. Understand the gap between wired and wireless networks
3. Build the knowledge of security building blocks which enable them to solve the problems of designing security solutions in wireless networks.
4. Learn the wireless LAN authentication protocols in detail, and enhance the skills of configuring a secure wireless network.

Unit 1: Fundamentals of Wireless Communication - Fundamentals of Wireless Communication, Advantages, Limitations and Applications, Wireless Media, Infrared Modulation Techniques, DSSS and FHSS, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA, Frequency Spectrum, Radio and Infrared Frequency Spectrum

Unit 2: Wireless local area networks (WLAN) - Introduction, Types of WLANs, WLAN Equipment, WLAN topologies and Technologies, IEEE 802.11 WLAN: Architecture, Physical Layer Standards.

Unit 3: WLAN Medium access control - Challenges for the MAC, MAC Access Modes and Timing, Contention-Based Access Using the DCF, Fragmentation and Reassembly, Frame Format, Encapsulation of Higher-Layer Protocols Within 802.11, Contention-Based Data Service

Unit 4: WLAN Framing - General frame format, Frame Control field, Format of individual frame types: Control frames, Data frames, Management frames, Types of Management Frames Management Frame fields, Frame Transmission and Association and Authentication States

Unit 5: Wireless Security - Wireless Application Protocol, WAP Security, Authentication, Integrity, Confidentiality, Security Issues with Wireless Transport Layer Security (WTLS), Wireless LAN Security, Access Point Security, Work Station Security, Safeguarding Wireless LAN's.

Unit 6: WLAN Security and Authentication - Cryptographic Background to WEP, WEP Cryptographic Operations, Problems with WEP, The Extensible Authentication Protocol, EAP Packet Format, EAP Requests and Responses, EAP Success and Failure, EAP Exchange, 802.1x: Network Port Authentication, 802.1x Architecture and Nomenclature, EAPOL Encapsulation, 802.1x Exchange, 802.1x on Wireless LANs

Recommended Books:

1. Eldad Perahia and Robert Stacey, Next Generation Wireless LANs: 802.11n and 802.11ac (2nd Edition), Cambridge University Press 2010.
2. Matthew S. Gast, O'Reilly, 802.11 Wireless Networks: The Definitive Guide, 2nd Edition, Media, Inc.1998.
3. Pejman Roshan, Jonathan Leary, 802.11 Wireless LAN Fundamentals, Cisco Press, 2014.
4. Brijendra Singh, Network Security and Management, 3rd edition, PHI 2000.

BTEC-906B-18	Credits	L	T	P	Int	Ext
Satellite Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to the understanding of Satellite Communication.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Understand the Phenomena in Satellite communication.
4. Understand the general Link Design equation and the concepts related to it.
5. Learn about VSAT system and its applications.

Unit 1 - Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit 2 - Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Altitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit 3 - Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Doppler frequency shift phenomena and expression for Doppler shift. Received signal power equations.

Unit 4 – Satellite Link Design: Introduction, General Link Design Equations, System Noise Temperature C/N and G/T Ratio, Atmospheric and Ionospheric Effects on Link design, Uplink design, Complete Link Design, Interference effects on Complete Link design, Earth Station Parameters.

Unit 5 – VSAT Satellite Systems: Introduction, Network Architecture, VSAT Earth Station, VSAT Applications.

Recommended Books:

1. Trimothy Pratt, Charles W. Bostian, —Satellite Communications‖, John Wiley & Sons, 1986.
2. Dr. D.C. Aggarwal, —Satellite Communications‖, Khanna Publishers, 2001.
3. Dennis Roddy, —Satellite Communications‖, McGraw Hill, 1996.

BTEC-906C-18	Credits	L	T	P	Int	Ext
CMOS and RF Circuit Design	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand and learn the important concepts related to CMOS and RF Circuit Design.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Get familiar with the concepts of CMOS and RF circuit designs.
2. Explore the design methods of RF receivers and transmitters.
3. Understand the concepts of Mixed signal design.
4. Use the design methods of Receivers and Transmitters.

Unit 1: CMOS Physics, Transceiver Specifications and Architecture - Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise – Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures, Direct up conversion Transmitter, Two step up conversion Transmitter.

Unit 2: RF Circuits Design – Overview: RF Filter Design, Design issues in Integrated RF filters, Active RF components, Matching and Biasing networks, Basic blocks in RF systems & their modelling, Design of LNA, Mixer, RF frequency synthesizer and RF Oscillators, Phase noise, Noise power and trade off, MOSFET behavior at RF frequencies, Integrated parasitic elements at high frequencies.

Unit 3: Impedance Matching and Amplifiers - S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match.

Unit 4: Mixed Signal Design – Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission, Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Recommended Books:

1.Thomas Lee," The Design of Radio Frequency CMOS Integrated Circuits", Cambridge University Press, 2nd Edition, Cambridge, 2004.
2.Matthew M. Radmanesh," Radio frequency and Microwave Electronics illustrated", Pearson Education Inc, Delhi, 2006.
3.B.Razavi, "RF Microelectronics", Pearson Education, 1997.
4.Devendra.K. Misra," Radio Frequency and Microwave communication Circuits – Analysis and Design", John Wiley and Sons, Newyork,2004.

BTEC-906D-18	Credits	L	T	P	Int	Ext
C# AND .NET Programming	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to C# and .NET Programming.

Course Outcomes

At the end of this course students will demonstrate the ability

1. Write various applications using C# Language in the .NET Framework.
2. Develop distributed applications using .NET Framework.
3. Create mobile applications using .NET compact Framework.
4. Learn other concepts of .NET approach towards problem solving

Unit 1: C# Advanced Features - Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT 2: Object Oriented Aspects of C# - Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism, sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.

Unit 3: Base Class Libraries & Data Manipulation - Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization -Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions -ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

Unit 4: .NET Framework and Compact Framework - Assemblies – Shared assemblies – Custom Hosting with CLR Objects – App domains -Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging -Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

Recommended Books:

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, Programming C# 4.00, OReilly, Fourth Edition, 2010.
2. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.
3. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.
4. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
5. Andy Wigley, Daniel Moth, Peter Foot, Mobile Development Handbook0, Microsoft Press, 2011.

BTEC-906E-18	Credits	L	T	P	Int	Ext
Natural Language Processing	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Natural Language Processing.

Course Outcomes

1. Demonstrate a basic understanding of the concepts of Natural language Processing
2. Learn about various Word forms and models therein
3. Understand Structures by using Parsing and its Algorithms
4. Explain about the Lexical knowledge Networks and related Web applications

Unit 1 – Introduction: Biology of speech processing, place and manner of articulation, word boundary detection, Argmax computation, HMM and speech recognition

Unit 2 - Words and Word forms: Morphology fundamentals, Morphological diversity of Indian languages, Morphology paradigms, FSM based morphology, automatic morphology learning, shallow parsing, named entities, Maximum entropy models, random fields

Unit 3 – Parsing :Context-free grammars and languages, Theories of Parsing, Parsing algorithms, rule based and probabilistic parsing, scope ambiguity and attachment ambiguity resolution

Unit 4 – Word Sense and Word Net : Lexical knowledge networks, Wordnet theory, Indian languages wordnet, multilingual dictionaries, semantic roles, word sense disambiguation, metaphors

Unit 5 - Web 2.0 Applications: Sentiment Analysis, text entailment, robust and scalable machine translation, question answering, multilingual setting, cross lingual information retrieval.

Recommended books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009.
2. James A.. Natural language Understanding 2e, Pearson Education, 1994.
3. Bharati A., Sangal R., Chaitanya V.. Natural language processing, PHI, 2000.
4. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP,2008.

5. Christopher Manning and HinrichSch• utze, Foundations of Statistical Natural Language Processing, MIT Press , 1999

BTEC-611-18	Credits	L	T	P	Int	Ext
Optical Fibres and Communication Lab	1	0	0	2	30	20

Course Objective

This is one of the experimental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. To perform experiments based on optical communication in order to understand in depth concepts of latest communication system.
2. To study various types of optical sources and light detectors
3. To know methods of slicing and connecting techniques of optical fibres
4. To study different types of losses in optical fibres.
5. To know applications of optical fibres.

List of Experiments:

The student has to perform 8 to 10 Lab experiments from the below:

1. Study and measurement of Attenuation and Loss in optical fibre.
2. Study and measurement of bending loss in optical fibre.
3. Study and measurement of numerical aperture of optical fibre.
4. Measurement of optical power using optical power meter.
5. To Study the transmission of TDM signal through optical fibre.
6. To determine the bit rate of the optical fibre link.
7. Study of various multiplexing techniques.
8. To determine the BER of wireless system using M-ARY (BPSK,QPSK,8PSK,16PSK) and QAM technique.
9. To learn fibre splicing techniques and to become familiar with the use of optical time domain reflectometry in characterizing optical fibres.
10. To establish fibre optic analog link and to study the relationship between the input signal & received signal.
11. To study the VI characteristics of fibre optic source and Photo Detector.
12. Simulation of an optical communication system & calculation of its BER and Q factor using simulator.

BTEC-612-18	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of various types of Microwave components and important measurements related to Microwave and Antenna Engineering.

Course Outcomes

At the end of this course students will demonstrate the ability to:
1. Learn about general Microwave components and Microwave bench.
2. Measure common parameters related to Microwave Oscillator(s).
3. Determine frequency and wavelength of waveguides.
3. Measure and plot radiation patterns of various types of Antennas.

List of Experiments:

The student has to perform 8 to 10 Experiments from the below:
1. To study various Microwave Components and Instruments.
2. To study the V-I Characteristics of Gunn Diode Oscillator at X-band.
3. To study Output power and Frequency as a function of voltage using Gunn Diode Oscillator at X-band.
4. To Study the characteristics of a Reflex Klystron oscillator.
5. To determine the Standing Wave Ratio (SWR) and Voltage standing wave ratio (VSWR).
6. To measure the dielectric constant of a material at X-band.
7. To determine the frequency & wavelength in a rectangular waveguide.
8. Measurement of coupling factor and Isolation of a Directional coupler using X-band.
9. To measure the Attenuation/Insertion Loss of an attenuator.
10. Determination of the phase-shift of a phase shifter.
11. To plot the Radiation pattern of an antenna.
12. To study Simple Dipole ($\lambda/2$ or $\lambda/4$ or $3\lambda/2$) antenna (all or any of these single dipole antennas) and Folded Dipole $\lambda/2$ antenna.
13. To study 3/5/7-element Yagi-Uda Folded Dipole antenna.
14. To study the Radiation pattern, Gain, Directivity of a Slot/Loop Antenna.

BTEC-631-18	Credits	L	T	P	Int	Ext
Project – I	3	0	0	3	60	40

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

This is expected to provide a good initiation for the student(s) in R&D work. The assignment may normally include:
1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

The students shall have to design two Projects (i.e. Project-I and Project-II in 6th Semester and 7th Semester, respectively). The projects must involve originality, innovation and business idea. Assessment will be based on the work performance & report submitted.

BMPD-361-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Head
Department of Electronics & Communication Engineering
IK Gujral Punjab Technical University
Main Campus, Kapurthala (Punjab)-144603

SEVENTH/EIGHTH SEMESTER

B.Tech.

Electronics & Communication Engineering (ECE)

Syllabus

IKGujral Punjab Technical University

Jalandhar-Kapurthala Highway, Kapurthala-144603 (PB)

Professional Electives - 3

BTEC-907A-18	Credits	L	T	P	Int	Ext
Internet Of Things (IOT) & Cloud Computing	3	3	0	0	40	60

Course Objective:
The main objective of this course is to enlighten the students with the basic concepts of Internet of Things (IoT) & Cloud Computing along with the services and application by their types which would facilitate to the humans to solve the real world problems.

Course Outcomes:
After completion of the course, the students would able to:
1. Understanding concept of cloud computing and analyze trade-off between deploying application on cloud and using local infrastructure
2. Identify issues and design challenges in IoT applications.
3. Select appropriate hardware and software components for IoT applications.
4. Conceptual knowledge will help students to build IOT applications.

Unit-I Introduction & Overview of Internet of things - The Internet of things today and tomorrow, Vision of internet of things, An IoT architecture outline ,Functional blocks of IOT ,industrial IOT, IOT enabled Smart devices in market, Application areas for IOT, Challenges in IOT. Hardware and Software tools required for IOT application development, Overview of IOT based on Texas instruments Hardware platforms and IDE's for development.

Unit- II Internet/Web and Networking Basics - Introduction to Internet & network topologies, TCP/IP protocol, TCP/IP Layers and their relative Protocols, IP addressing(IPV4), IP Address Classification & Subnetting, Local IP , Gateway IP and DNS,TCP & UDP Communication, Access point and Station model, Wireless networks, Encryption standards and signal strength of WiFi network, Overview of MAC Address, Energia WiFi Library API's .

Case Study : Connected microcontrollers essential to automation in buildings.

Unit-III Web servers and Client Communication- Introduction to a Web server and its types, Role of servers over Internet, Port numbers, Socket Communication, WiFi Web Client, Client server Communication model with Example, Overview of HTTP protocol, HTTP based web server, Sensor interfacing with network, basics of HTML, Client and Server class API's.

Unit-IV Cloud Communication in IOT- IOT device to cloud storage communication Model, need of Cloud services in IOT, ,Different Cloud storage services available today, Cloud Data processing and frame format, Role of Smart phones in IOT, Examples on Home automation and Smart city development, Introduction to clouds like Temboo, Blynk, Pubnub etc.

Case Study : Advances in bio-inspired sensing help people lead healthier lives.

Unit-V IOT Plate form and Application development- Remote Monitoring & Sensing, Remote Controlling, Application development using MQTT Protocol, Sensors and sensor Node and interfacing using Embedded target boards (TM4C123x & CC31xx), IoT applications in home, infrastructures, Healthcare, Transport, buildings, security, Industries, and other IoT electronic equipment, Adapting IPV6 for IOT Requirement (overview).

Suggested Books

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrate Ecosystems, River Publishers 2010.
2. Jan Axelson, Embedded Ethernet And Internet Complete (Designing and Programming Small Devices for Networking) 2014.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach, McGraw Hill 2013.
4. Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann. Interconnecting Smart Objects with IP: The Next Internet.
5. Raj Kumar Buyya, James Broberg, Cloud Computing: Principles and paradigms 2000.
6. Barrie Sosinsky, Cloud Computing Bible, Wiley Publications 1999.
7. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Tata MacGrawHill 1997.

References

1. http://www.ti.com/ww/en/internet_of_things/iot-overview.html.
2. http://energia.nu/reference/
3. *Internet of Things (IoT): A vision, architectural elements, and future directions Jayavardhana Gubbia, Rajkumar Buyyab, *, Slaven Marusic a, Marimuthu Palaniswami a*
4. http://www.ti.com/wireless-connectivity/simplelink-solutions/overview/overview.html.
5. https://www.hivemq.com/blog/mqtt-essentials-part2-publish-subscribe.

BTEC-907B-18	Credits	L	T	P	Int	Ext
Antenna Radiating Systems	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of Antenna Radiating Systems and its fundamentals.

Course Outcomes

At the end of the course, students will demonstrate the ability

- To understand the basic concepts of radiation.
- To understand various antenna types.
- To analyse the radiation pattern of antenna arrays.
- To understand the concept of various wave propagation techniques.

- To understand the concept of radiating systems on environment.

Unit 1: Antenna Fundamentals - Power density, directivity, gain, radiation resistance, input impedance, radiation patterns, beam width, bandwidth and polarization. Retarded potential, Matching – Baluns, Polarization mismatch, Antenna noise temperature & SNR, Linear and array antennas - Arrays of two point sources – Broad side and end fire arrays, binomial array - Principle of pattern multiplication –Adaptive arrays.

Unit 2: Fundamentals of Radiation - Radiation from a current element and monopole – Radiation from a Quarter-wave dipole, half-wave and centre-fed dipole – Near and far fields, current distribution of dipole antennas. Radiation from oscillating dipole, Half wave dipole, Folded dipole. Radiation through an Aperture, Radiation from Electromagnetic Horns.

Unit 3: Special Purpose Antennas: (Qualitative treatment only) Loop antennas, Travelling wave antennas, V and rhombic antennas, Horn antennas, Yagi-Uda arrays, Wideband antennas, Log periodic antennas. Babinet's principle – Slot radiators- Parabolic reflectors – Radiation pattern, aperture efficiencies – Feeding techniques for parabolic antennas.

Unit 4: Antenna Measurements - Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods).

Unit 5: Environmental effects - Concept of Electromagnetic interference (EMI); EMC and its advantages. effect of radiating systems on environment, techniques to suppress EMI.

Recommended Books:

1. Constantine A. Balanis, Antenna Theory: Antenna & Design 4th Edition, 2016, Wiley.
2. A. R. Harish, M. Sachidananda. Antennas and Wave Propogation, 2011, Oxford University Press.
5. Edward Conrad Jordan and Keith George Balmain, Electromagnetic Waves and Radiating Systems, PHI.
6. R.L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi.
7. A. Das, Sisir K. Das, Microwave Engineering, Tata McGraw Hill.
8. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, Antennas and Wave Propagation, Fourth Edition, 1980, Tata McGraw Hill.

BTEC-907C-18	Credits	L	T	P	Int	Ext
Robotics and Embedded Systems	3	3	0	0	.40	60

Course Objective:

The main objective of this course is to enlighten the students with the basic fundamentals of Robotics, Robotic Transformation, Simulation and programming along with the Embedded systems in Robotics so that they will be able to design the robots which would facilitate to the humans to solve the real world problems.

1. Ability to understand basic concept of robotics.
2. To analyze Instrumentation systems and their applications to various
3. To know about the differential motion, add statics in robotics
4. To know about the various path planning techniques.
5. To know about the dynamics and control in robotics industries.

UNIT I - BASIC CONCEPTS

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors-work cell-Programming languages.

UNIT II - DIRECT AND INVERSE KINEMATICS

Mathematical representation of Robots-Position and orientation–Homogeneous Transformation-Various Joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct Kinematics-Inverse kinematics-SCARA robots-Solvability–Solution Methods-Closed form solution.

UNIT III - MANIPULATOR DIFFERENTIAL MOTION AND STATICS

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.

UNIT IV - PATH PLANNING

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric Descriptions-Straight line and circular paths-Position and orientation planning.

UNIT V - ROBOTICS SYSTEM DESIGN

Running Code on Microcontroller-Voltage, Current and power-ARM Cortex M-Software Design-Battery and Voltage Regulation-GPIO-Interfacing Input and Output-DC Motors-Timers-Bluetooth Low Energy.

Suggested Books:

1.R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

2.JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.

3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-HillSingapore, 1996.

4. Jonathan W. Valvano, Embedded Systems: Introduction to Robotics, First Edition,2019

5. TI Robotic System Design Lab-RSLK (https://university.ti.com/en/faculty/ti-robotics-system-learning-kit/ti-robotics-system-learning-kit)

BTEC-907D-18	Credits	L	T	P	Int	Ext
Python Programming	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Python programming, its functions & the concept of Eratosthenes.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Read and write simple Python programs.
2. Develop Python programs with conditionals and loops.
3. Define Python functions and to use Python data structures–lists, tuples, dictionaries.
4. Perform input/output operations with files in Python.
5. Execute Searching, sorting and merging in Python.

Unit I: Introduction - The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit 2: Functions - Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. String: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries Higher Order Functions: Treat functions as first class Objects, Lambda Expressions.

Unit 3: Sieve of Eratosthenes - Generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O: File input and output operations in Python Programming Exceptions and Assertions

Unit 4: Modules and Classes - Modules: Introduction, Importing Modules, Abstract Data Types: Abstract data types and ADT interface in Python Programming. Classes: Class definition and other operations in the classes, Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.), Class Example, Inheritance, Inheritance and OOP.

Recommended Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/OReilly Publishers, 2016.
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,,2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programsl, CENGAGE Learning, 2012.
7. Charles Dierbach, Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

BTEC-907E-18	Credits	L	T	P	Int	Ext
Adaptive Signal Processing	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Adaptive Signal Processing and related algorithms.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the non-linear control and the need and significance of changing the control parameters with respect to real-time situation.
2. Mathematically represent the 'adaptability requirement'.
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

Unit 1: General concepts of Adaptive Signal Processing – General Aspects of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 2: Adaptive Signal Processing Algorithms - Optimal (Wiener) filter, Method of steepest descent, extension to complex valued, LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Unit 3: Signal space concepts - introduction to finite dimensional vectors pace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram- Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces. Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 4: Introduction to recursive least squares (RLS) - vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Recommended Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
3. Alexender Thomas 1984/86.

Professional Electives - 4

BTEC-908A-18	Credits	L	T	P	Int	Ext
Artificial Intelligence	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Artificial Intelligence Networks, Systems, Methods and parameters.

Course Outcomes

At the end of this course students will demonstrate the ability to:

- Learn about the basic understanding of Artificial Intelligent system
- explain about various types of Artificial Neural Networks & their models
- describe Artificial Neural networks methods, operation and parameters
- explore Neural Network MATLAB Toolbox

Unit 1 - Introduction

Approaches to intelligent control, Architecture of intelligent control, Linguistic reasoning, Rulebase, Knowledge representation.

Unit 2 - Artificial Neural Networks

Biological neuron, Artificial Neural Network (ANN), Mathematical Models, McCulloch Neural Model, Perceptron, Adaline and Madaline, Learning & Training in ANN, Hopfield Neural Network, Self Organizing Networks, Recurrent Networks, Associative memories.

Unit 3 - Fuzzy Logic System

Crisp Vs Fuzzy set theory, Membership functions, Fuzzy set operations, Fuzzy rules, Mamdani and Sugeno fuzzy inference systems, Defuzzification methods.

Unit 4 – ANN Methods and Parameters

Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities.

Unit 5 – Fuzzy Logic MATLAB Toolbox

Fuzzy Logic Toolbox, Neural Network Toolbox, FLS for Antilock Breaking System (ABS), GA in route planning for Travelling Sales Person, Time-Series forecasting using ANN.

Recommended Books

1. Jacek M. Zurada - Introduction to Artificial Neural Systems, PWS Publishing Company 1995.
2. S N Sivanandam, S N Deepa - Principles of Soft Computing, Wiley Publications, 2007.
3. John Yen, Reza Langari - Fuzzy Logic Intelligence, Control, and Information, Pearson 1998.

BTEC-908B-18	Credits	L	T	P	Int	Ext
Mobile Communication and Networks	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of Mobile Communication and Networks.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance

Unit 1: Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards, Introduction to Generations – 2G to 5G.

Unit 2: Signal propagation- Propagation mechanism- Reflection, Refraction, Diffraction and Scattering, Large scale signal propagation, Fading channels-Multipath and small scale fading- Doppler shift, Statistical multipath channel models, Narrowband and Wideband fading models, Delay spread, Coherence bandwidth and Coherence time, Flat and frequency selective fading, Slow and Fast fading, Average fade duration and level crossing rate.

Unit 3: Othrogonal Frequency Division Multiplexing (OFDM) – OFDM Receiver & Transmitter structures- Diversity receivers- selection and MRC receivers, RAKE receiver, Equalization, Transmit diversity-Altamonte scheme.

Unit 4: MIMO and Space time signal processing - Spatial multiplexing, diversity/multiplexing tradeoff, Performance measures- Outage, SNR, symbol/bit error rate, examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall,1996.
6. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

BTEC-908C-18	Credits	L	T	P	Int	Ext
VLSI Design	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of VLSI Design and its concepts.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concepts and various processes related to VLSI
2. Understand the VLSI Circuit Design processes and Gate level design
3. Learn about VHDL Synthesis and the tools involved
4. Describe about CMOS Testing techniques

Unit 1: Introduction to VLSI & Basic Electrical properties - IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Oxidation, Lithography, Diffusion, Ion implantation, Metallisation, Encapsulation Probe testing, Integrated Resistors and Capacitors. Electrical Properties of MOS and BiCMOS Circuits: I_{ds}-V_{ds} relationships, MOS transistor threshold Voltage, Body effect, g_m, g_{ds}, Figure of merit, Pass-transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Invertor.

Unit 2: VLSI Circuit Design Processes - VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Unit 3: Gate Level Design - Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations: Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-In/Fan-out.

Unit 4: VHDL Synthesis - VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools, Test Principles.

Unit 5: CMOS TESTING – Design for manufacturability, Introduction to CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Recommended Books:

1.Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition.

2. CMOS Digital Integrated Circuits Analysis & Design, S M Kang and Y Leblebici, McGraaw-Hill, Third Edition.

3.Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.

4.Chip Design for Submicron VLSI: CMOS Layout & Simulation, – John P. Uyemura, Thomson Learning.

5.Introduction to VLSI Circuits and Systems – John .P. Uyemura, JohnWiley, 2003.

6.Digital Integrated Circuits – John M. Rabaey, PHI, EEE, 1997.

7.Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.

8. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

BTEC-908D-18	Credits	L	T	P	Int	Ext
Soft Computing	3	3	0	0	40	60

Course Objectives

The main objective of this course is to enlighten the students with the basic fundamentals and concepts of Soft Computing and Algorithms.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concepts of Soft Computing and Algorithms involved there-in
2. Understand Genetic Algorithms with its operators and applications
3. Learn about the Neural Network models and its applications
4. Describe the Fuzzy systems and Swarm Intelligence

Unit 1: Introduction - What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing. Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

Unit 2: Neural Networks- Concept, biological neural system,. Evolution of neural network, McCullochPitts neuron model, activation functions, feed forward and feedback networks, learning rules – Hebbian, Delta, Perceptron learning and Windrow-Hoff,winner-take-all. Supervised learning- Perceptron learning, single layer/multilayer perceptron, Adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, Application of Neural networks in Image processing.

Unit 3: Fuzzy systems - Basic Definition and Terminology, Set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification.

Unit 4: Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Recommended Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley. ISBN13: 9788126527410, 2011.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", PrenticeHall of India, 2003.

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3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.

4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.

5. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.

6. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

BTEC-908E-18	Credits	L	T	P	Int	Ext
Digital Image and Video Processing	3	3	0	0	40	60

Course Objectives

This course deals with the concept, knowledge and background required for better understanding of Digital Image and Video Processing.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding.

Unit 1: Digital Image Fundamentals - Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit 2: Color Image Processing - Color models–RGB, YUV, HSI; Color transformations– formulation, Color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Image Segmentation - Detection of discontinuities, edge linking and boundary detection, region-based segmentation. Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, Continuous wavelet transforms, Wavelet bases and multi-resolution analysis, Wavelets and Sub band filter banks, Wavelet packets. Image Compression-Redundancy–inter-pixel and psycho-visual; Still image compression standards – JPEG and JPEG-2000.

Unit 3: Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Unit 4: Video Segmentation- Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Recommended Books:

1.R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008.
2.Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.
3. Murat Tekalp, Digital Video Processing" Prentice Hall, 2nd edition 2015.

Professional Electives - 5

BTEC-909A-18	Credits	L	T	P	Int	Ext
Big Data Fundamentals	3	3	0	0	40	60

Course Objectives

This course deals with knowledge of fundamentals, architecture and concepts for better understanding of Introduction of Big Data.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the Evolution and basics of Big Data.
2. Understand the Architecture of Hadoop with its file system and its Programming.
3. Explain the Advanced analytical theory and methods.
4. Describe the challenges in handling streaming data from the real world.

Unit 1 - Evolution & Introduction to Big data: Best Practices for Big data Analytics, Big data characteristics, Validating – The Promotion of the Value of Big Data, Big Data Use Cases, Characteristics of Big Data Applications, Perception and Quantification of Value, Understanding Big Data Storage.

Unit 2 - A General Overview of High Performance Architecture: HDFS, Map Reduce and YARN – Map Reduce Programming Model. Big Data Overview Analysis of data at Rest- Hadoop analytics: Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Hadoop cluster components, Hadoop Ecosystem, Evaluation criteria for distributed Map Reduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation

Unit 3 - Advanced Analytical Theory and Methods: Overview of Clustering – K-means, Use Cases, Overview of the Method, Determining the Number of Clusters, Clustering, Classification, Segmentation, Linear regression, ML Search: Indexing and Indexing Techniques, Create inverted index using JAQL, Data Explorer Bundling Hadoop job: Application, Diagnostics, Reasons to Choose and Cautions, Classification: Decision Trees, Overview of a Decision Tree, The General Algorithm – Decision Tree Algorithms, Evaluating a Decision Tree

Unit 4 - Real time analytics: Introduction to streams computing, Challenges/limitations of conventional Systems, Solving a real time analytics problem using conventional system, Challenges to be solved - scalability, thread pooling, etc., Understanding the challenges in handling streaming data from the real world and how to address those using stream computing, Benefits of stream computing in Big Data world, Realtime Analytics Platform (RTAP), Real Time Sentiment Analysis.

Recommended Books:

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Chris Eaton, Paul Zikopoulos, Wiley Publication 2015.
2. Big Data Analytics: Turning Big Data into Big Money By Frank J. Ohlhorst, McGraw Hill 2012.
3. Ethics of Big Data: Balancing Risk and Innovation By Kord Davis, 2011.
4. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends, By Michael Minelli, Michele Chambers, Ambiga Dhiraj, Wiley Publication 2013.

BTEC-909B-18	Credits	L	T	P	Int	Ext
Information Theory and Coding	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and importance with understanding of Information Theory and Coding along with coding techniques.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

Unit 1 – Basic Concepts of Information Theory: The concept of Amount of Information, Average Information, Entropy, Information rate, Shannon's Theorem, Mutual information; Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth - S/N Trade-off, Introduction to Channel Capacity & Coding, Channel Models, Channel Capacity Theorem, Shannon Limit. Huffman source coding algorithm, Lempel Ziv source coding algorithm.

Unit 2 - Introduction to Error Control Coding: Linear Block Codes: Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, Hamming Code. Cyclic Codes: Description of Cyclic codes, Generator and parity check matrices of cyclic codes, error detection decoding of cyclic codes. BCH Codes: Description of codes, Decoding of BCH codes, Implementation of error connection.

Unit 3 - Convolution Codes: Encoding of convolution codes, structural properties of Convolution codes, Distance Properties of convolution codes. Automatic Repeat Request Strategies: Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes.

Unit 4- Error Control Coding: Concatenated Codes and Turbo Codes, Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Text/Reference Books:

- 1. N. Abramson, Information and Coding, McGraw Hill, 1963.
- 2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
- 3. R.B. Ash, Information Theory, Prentice Hall, 1970.
- 4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
- Ranjan Bose, Information Theory, Coding and Cryptography, The McGraw Hill, 2007.
- Related IEEE/IEE Publications

BTEC-909C-18	Credits	L	T	P	Int	Ext
Embedded System Design	3	3	0	0	40	60

Course Objectives

This course deals with the concepts and design requirements for understanding the Embedded System Design and its fundamentals.

Course Outcomes

After the completion of this course, the student will be able to

- Learn about the basic architecture of 32-bit microcontrollers
- Understand hardware interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.
- Reviews and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.
- Understand Embedded Networking concepts based upon connected MCUs

UNIT-I: Introduction to Embedded systems

Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. Fixed point and Floating point arithmetic operations.

Introduction ARM architecture and Cortex – M series, Introduction to the Tiva family viz. TM4C123x(Cortex M4F) and its targeted applications, block diagram, address space, on-chip peripherals (Analog and Digital) Register sets, Addressing modes and instruction set basics.

UNIT-II: Microcontroller Fundamentals for Basic Programming

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I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Introduction to Interrupts, Interrupt vector table, interrupt programming.

UNIT- III: Timers, PWM and Mixed Signals Processing

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

UNIT-IV: Communication protocols and Interfacing with external devices

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol. Implementing and programming I2C, SPI & UART interface and CAN & USB interfaces on TM4C123x .

UNIT V: Embedded networking

Embedded Networking fundamentals, Ethernet, TCP/IP introduction, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi.

Recommended Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

BTEC-909D-18	Credits	L	T	P	Int	Ext
AI & Machine Learning	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and background required for better understanding of Artificial Intelligence (AI) and Machine Learning and its issues, challenges and fundamentals. The course actually possesses the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and Machine Learning.

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. To learn the difference between optimal reasoning Vs human like reasoning
2. To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3. To learn different knowledge representation techniques
4. To understand the applications of AI namely, Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

Unit –I: Foundations of AI and Intelligent Agents: What is AI, History of AI, Strong and weak AI, The State of the Art. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit –II: Basic AI Concepts and Machine Learning: Boolean Algebra, Expert Systems, Configuration of Device, Introduction to SWI Prolog, Installing prolog, Introduction to Fuzzy Logic, Basic of ML, Colour Selection Algorithm.

Unit –III: Solving Problems by Searching: Problem –Solving Agents, Example Problems, Searching for Solutions, uniformed search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Unit –IV: Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit –V: Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Learner Models, Nonparametric Models, Support Vector Machines, Ensemble Learning, Practical Machine Learning.

Suggested Text Books:

1."Artificial Intelligence A Modern Approach", Stuart J. Russell & Peter Norvig –Pearson.
2."Artificial Intelligence", Elaine Rich, Kevin Knight & Shivashankar B Nair –McGraw Hill Education.
3.Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier
4. T. Hastie, R. Tibshirani, J. Friedman ---The Elements of Statistical Learning, 2e, 2008.
5. C. Bishop --- Pattern Recognition and Machine Learning. 2e 2010.
6. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
7. E. Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
8. S. Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

BTEC-909E-18	Credits	L	T	P	Int	Ext
Biomedical Signal Processing	3	3	0	0	40	60

Course Objectives

The main objective of this course is to enlighten the students with the basic fundamentals and concepts of Biomedical Signal Processing.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Understand the fundamentals of signal processing for various bio-signal analysis

2. Learn the Infinite impulse response (IIR) filter and study its applications
3. Attain in-depth knowledge about the basic concepts of finite impulse response (FIR) filter and study its applications
4. Apply different methods of signal processing techniques in analyzing the various bio-signals such as Electro cardiogram (ECG), Electro myogram (EMG) and Phonocardiogram (PCG)

Unit 1: Fundamentals of Biomedical Signal Processing (BSP) - Different types of Bioelectric signals and its basic characteristics, Sampling and aliasing, simple signal conversion systems, spectral analysis, FFT - Decimation in Time algorithm and Frequency algorithm.

Unit 2: IIR and FIR Digital Filter Design and Application - Characteristics of IIR and FIR filters, Impulse invariant method, Design of Bilinear transformation and Impulse invariant method using Butterworth technique, Design of Bilinear transformation and Impulse invariant method using Chebyshev technique, Warping and pre-warping effect, Fequency transformation, FIR filter design using windowing techniques- Rectangular, Hamming, Hanning, Blackmann Windows, Time domain filters- synchronized averaging, moving average filters.

Unit 3: Analysis of Bio-Signals for Signal Processing - P-Wave detection, QRS complex detection-derivative based method, Pan Tompkins algorithm, Template matching method, Signal averaged ECG, Analysis of heart rate variability-time domain method and frequency domain methods, Synchronized averaging of PCG envelopes, Envelogram, analysis of PCG signal, EMG signal analysis, ECG rhythm analysis, normal and ectopic ECG beats, analysis of exercise ECG, Analysis of respiration, spectral analysis of EEG signals. Multimedia Applications.

Recommended Books:

1.Rangaraj.M.Rangayyan, Biomedical signal processing, Wiley-IEEE press, 2nd edition, 2015.
2.S.Salivahnan, C.Gnanapriya, Digital signal processing, Tata McGraw-Hill, New Delhi, 2nd edition 2011.
3.John G. Proakis and DimitrisG. Manolakis, Digital signal processing, algorithms and applications, PHI of India Ltd., New Delhi, 4th edition, 2007.
4.Reddy D.C, Biomedical signal processing: Principles and techniques, Tata McGraw-Hill, New Delhi, 2nd edition, 2005.

Open Elective - 2

(The List of Open Electives (OE) courses offered is provided in the Study Scheme)

Open Elective - 3

(The List of Open Electives (OE) courses offered is provided in the Study Scheme)

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Mandatory Courses

The syllabus of these courses is on the lines of AICTE Model Curriculum 2018

BTMC-101-18	Credits	L	T	P	Int	Ext
Indian Constitution	Non-credit	3	0	0	40	60

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does nottruly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1 Meaning of the constitution law and constitutionalism
2 Historical perspective of the Constitution of India
3 Salient features and characteristics of the Constitution of India
4 Scheme of the fundamental rights
5 The scheme of the Fundamental Duties and its legal status
6 The Directive Principles of State Policy–Its importance and implementation
7 Federal structure and distribution of legislative and financial powers between the Union and the States
8 Parliamentary Form of Government in India – The constitution powers and status of the President of India

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9 Amendment of the Constitutional Powers and Procedure
10 The historical perspectives of the constitutional amendments in India
11 Emergency Provisions : National Emergency, President Rule, Financial Emergency
12 Local Self Government – Constitutional Scheme in India
13 Scheme of the Fundamental Right to Equality
14 Scheme of the Fundamental Right to certain Freedom under Article19
15 Scope of the Right to Life and Personal Liberty under Article21

Course Objectives: The objective of the course is to provide the basic knowledge about the Political System of the Country. The basic idea is to make the students aware of their duties and rights. Apart from it the course will aim to educate the pupils about the working of different organs of the government, various constitutional bodies and the agencies of the government. In addition to it, students will be given brief knowledge regarding the different challenges of Indian Political System, forms of Government in India and nature & dimensions of Indian Federal System. Course Pedagogy: Since the course is of Practical Importance, it is recommended that during the course students will be taken out for one visit to any place with the potential of imparting practical knowledge to the students about the Indian Political System. Such places can be Indian Parliament. State Legislative Assembly, Youth Parliament Pune. It is expected that students should be given case studies about the Indian Political System and Debates on Constitutional Issues should be organised in the campus.

Course Outcome: After the successful completion of the course students will be to understand the different dimensions of Indian Political System. They will be aware about their duties towards the fellow citizens. Students will be able to challenges of the democratic institutions and theoretical aspects of the state and its organs.

Suggested Reading:

1. Indian Political System by J C Johri
2. Indian Political System by Mahendra Prasad Singh
3. Fundamentals of Indian Political System by Rajesh K Jha.
4. Our Constitution by Subhash C Kashyap
5. Our Political System by Subhash C Kashyap
6. Indian Federalism – An Introduction by Mahendra Prasad Singh
7. Indian Federalism and Autonomy by S Chandrasekhar

BTMC-102-18	Credits	L	T	P	Int	Ext
Essence of Indian Traditional Knowledge	Non-credit	3	0	0	40	60

Part-1 Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions.

Part-1 focuses on introduction to Indian Knowledge System. Indian perspective of modern scientific world -view and basis principal of Yoga and holistic health care system.

Course Outcomes

-Ability to understand connect up and explain basics of Indian traditional Knowledge in Modern scientific perspective.
-Ability to understand connects up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

Course contents

i. Basic Structure of Indian Knowledge system
ii. ii. Modern Science and Indian Knowledge system
iii. Yoga and Holistic Health Care
iv. iv. Case studies

References

• Fritz of Capra Too of Physics
• Fritz of Capra The Wave of life
• Yoga Sutra of Patanjali. Ramakrishna Mission. Kolkata.
• RN Jha Science of Consciousness Psychotherapy and Yoga Practices. Vidyanidhi Prakashan. Delhi2016
• PB Sharma (English translation) Shodashang Hridayam

Pedagogy: Problem based learning, group discussion, collaborative mini projects

Part-2 Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions

Part-2 focuses on Indian philosophical traditions. Indian linguistic Tradition, and Indian artistic tradition.

Course contents

i. Philosophical Tradition
ii. Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
iii. Indian Artistic Tradition
iv. Case studies

References

• V.Sivaramakrishnan (Ed.), Cultural Heritage of India-Course material, Bhartiya Vaidya Bhawan Mumbai 5th Edition 2014
• S.C Chaterjee &D.M .Datta , An introduction to Indian Philosophy ,University of Calcutta 1984.
• KS Subrahmanialyer ,Vakyapadiya of Bhattaraihari (Brahma Kanda), Deccan College Pune 1965
• VN Jha, Language Thought and Reality
• Pramod Chandra. India Arts Howard Univ. Press 1983
• Krishna Chaitanya Arts of India. Abhinav Publications. 1987
• R Nagaswamy , Foundations of Indian Art Tamil Arts Academy.2002

Pedagogy: Problem based learning, group discussion, collaborative mini projects

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BTEC-731-18	Credits	L	T	P	Int	Ext
Project Stage - II	6	0	0	12	120	80

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up during Project-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Prototyping or Product development/Patent and Video demonstration;
6. Preparing a paper for Conference presentation/Publication in Journals;
7. Preparing a Dissertation in the standard format for being evaluated by the Department;
8. Final Seminar Presentation before a Departmental Committee.

BMPD-371-18	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* As stated in the IKGPTU B.Tech 1st Year Scheme and Syllabus

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students

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6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty in charges shall maintain proper record student wise of each activity conducted

and the same shall be submitted to the department.

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M. Tech ECE

(Wireless Communication)

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M.Tech. ECE (Wireless Communication) 2018 Study Scheme

Semester-1

Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
MTWC-101-18	Wireless Communication	3	0	0	40	60	100	3
MTWC-102-18	Information Theory & Coding	3	0	0	40	60	100	3
MTWC-PE1X-18	Elective I	3	0	0	40	60	100	3
MTWC-PE2Y-18	Elective II	3	0	0	40	60	100	3
MTWC-111-18	Wireless Communication Lab	0	0	4	60	40	100	2
MTWC-112-18	Information Theory & Coding Lab	0	0	4	60	40	100	2
MTRM-101-18*	Research Methodology & IPR	2	0	0	40	60	100	2
MTAXX-18	Audit Course I	2	0	0	S/US**	S/US**	100	Non-credit
	Total	**14**	**0**	**8**	**320**	**380**	**800**	**18**

Semester-2

Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
MTWC-103-18	Advanced Wireless Communication	3	0	0	40	60	100	3
MTWC-104-18	Soft Computing Techniques	3	0	0	40	60	100	3
MTWC-105-18	Simulation of Wireless Communication Systems	3	0	0	40	60	100	3
MTWC-PE3X-18	Elective III	3	0	0	40	60	100	3
MTWC-PE4Y-18	Elective IV	3	0	0	40	60	100	3
MTWC-113-18	Wireless Communication Simulation Lab	0	0	4	60	40	100	2
MTWC-MP1-18	Mini Project	0	0	4	60	40	100	2
MTAXX-18	Audit Course II	2	0	0	S/US**	S/US**	100	Non-credit
	Total	**17**	**0**	**8**	**320**	**380**	**800**	**19**

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Semester-3

Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
MTWC-PE5X-18	Elective V	3	0	0	40	60	100	3
MTOE-301X-18*	Open Elective	3	0	0	40	60	100	3
MTWC-DS1-18	Dissertation Phase I#	0	0	20	60	40	100	10
	Total	**6**	**0**	**20**	**140**	**160**	**300**	**16**

Semester-4

Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
MTWC-DS2-18	Dissertation Phase II#	6	0	20	60	40	100	16
	Total	**6**	**0**	**20**	**60**	**40**	**100**	**16**
					840	**960**	**2000**	**69**

* These courses are common to all M.Tech. Courses.

**S/US - Satisfactory/Unsatisfactory

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#The distribution of marks for evaluation of Dissertation Phase I and II shall be as under:

The following is the proposed composition of Departmental Research Committee (DRC) for M.Tech./ME evaluation and grading:

Head of Department (HOD)	Chairman
One faculty member as Department PG Coordinator (nominated by HOD)	Member
Supervisor(s)	Member(s)

Dissertation Phase I

(A) Internal Marks to be awarded by the Departmental Research Committee (DRC) for Dissertation Phase I:

1. Presentation-I (a. Subject Matter, b. Knowledge of Research Area, c. Literature Review, d. Response to Questions asked)	20
2. Presentation-II (a. Tentative Title, b. Objectives, c. Methodology, d. Problem Statement, d. Research Gap, e. Response to Questions asked)	20
3. Report	20
	60

(B) External Marks to be awarded by External Expert for Dissertation Phase I:
All members will award the remaining Forty (40) marks assigned to the viva-voce examination as per the following. HOD will approve the name of External Expert.

1. Presentation Structure	10
2. Response to Questions asked during presentation	10
3. Usefulness/Contribution of the work to the field	10
4. Evaluation of Report by External Expert	10
	40

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Dissertation Phase II

(A) Internal Marks to be awarded by the Departmental Research Committee (DRC) for Dissertation Phase II:

1. Presentation-I (a. Final Title, b. Methodology (Simulation Tool(s), c. Performance evaluation regarding the implementation techniques, d. Response to Questions asked)	20
2. Presentation-II (a. Objectives achieved, b. Relevance of Research Work, c. Response to Questions asked)	20
3. M.Tech Dissertation (Plagiarism Check)	20
	60

The HOD shall take the names of External Examiners (three senior faculty members) from the Supervisor and send the same to the Higher Authority as per University Norms.

(B) External Marks to be awarded by External Expert for Dissertation Phase II:
All members will award the remaining Forty (40) marks assigned to the viva-voce examination as per the following:

1. Presentation Structure (including M.Tech. Thesis)	10
2. Response to Questions asked during presentation	10
3. Usefulness/Contribution of the work to the field	10
4. Publication of paper(s) to Journal of repute	10
	40

Duties of DRC:

1. To Evaluate M.Tech Dissertation Phase-I and Phase-II.
2. To take approval from higher authority for External Expert.

Note: Decision of DRC will be final in all relevant cases.

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Study Scheme 2018 M.Tech. ECE (Wireless Communication)-Program Electives

	Program Elective I
MTWC-PE1A-18	Wireless Sensor Networks
MTWC-PE1B-18	RF MEMS for Wireless Communication
MTWC-PE1C-18	Advanced Digital Signal processing
MTWC-PE1D-18	Audio & Video Signal Processing
	Program Elective II
MTWC-PE2A-18	Advanced Communication Systems
MTWC-PE2B-18	Detection & Estimation Theory
MTWC-PE2C-18	Mobile Adhoc Networks
MTWC-PE2D-18	Optical Network and Photonic Switching
	Program Elective III
MTWC-PE3A-18	Smart Antennas
MTWC-PE3B-18	Wireless Network Planning, Optimization and Mnagement
MTWC-PE3C-18	Microwave and RF Design
MTWC-PE3D-18	Multimedia Communication and Technology
	Program Elective IV
MTWC-PE4A-18	Cryptography and Wireless Security
MTWC-PE4B-18	Software Defined Radio & Cognitive Radio
MTWC-PE4C-18	Wireless & Optical Communication Networks
MTWC-PE4D-18	MIMO Systems
	Program Elective V
MTWC-PE5A-18	Millimeter Wave Communication and Technology
MTWC-PE5B-18	Space Time Wireless Communication
MTWC-PE5C-18	Advance Techniques for Wireless Reception
MTWC-PE5D-18	Emerging Technologies in Wireless Communication
MTWC-PE5E-18	Microstrip Antennas

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Study Scheme 2018 M.Tech. ECE (Wireless Communication)

Audit Courses I and II & Open Electives

	List of Audit Courses
MTA101-18	English for Research Paper Writing
MTA102-18	Disaster Management
MTA103-18	Sanskrit for Technical Knowledge
MTA104-18	Value Education
MTA105-18	Constitution of India
MTA106-18	Pedagogy Studies
MTA107-18	Stress Management by Yoga
MTA108-18	Personality Development through Life Enlightenment Skills
	Open Electives
MTOE- 301A-18	Business Analytics
MTOE- 301B-18	Industrial Safety
MTOE- 301C-18	Operations Research
MTOE- 301D-18	Cost Management of Engineering Projects
MTOE- 301E-18	Composite Materials
MTOE- 301F-18	Waste to Energy

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First Semester

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MTWC-101-18 WIRELESS COMMUNICATION	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

To enable students understand the various aspects of wireless communication, factors affecting the communication link and physical models.

Course Outcomes

After the completion of the course, the student will be able to:

1. Implement physical models of wireless channels.
2. Gain knowledge of key concepts of wireless communication.
3. Measure capacity of AWGN channel, LTI Gaussian channels and various fading channels.
4. Study uplink and downlink model of AWGN channel, fading channels and multiuser diversity.

Unit I Physical modelling for wireless channels: Free space, fixed transmit and receive antennas, Free space, moving antenna, Reflecting wall, fixed antenna, Reflecting wall, moving antenna, Reflection from a ground plane, Power decay with distance and shadowing, Moving antenna, multiple reflectors

Unit II Input /output model of the wireless channel: The wireless channel as a linear time-varying system, Baseband equivalent model, discrete-time baseband model, Additive white noise

Unit III Time and frequency coherence: Doppler spread and coherence time, delay spread andcoherence bandwidth

Unit IV AWGN channel capacity: Repetition coding, Packing spheres, Capacity-achieving AWGNchannel codes, Reliable rate of communication and capacity, Resources of the AWGN channel-Continuous-time AWGN channel, Power and bandwidth, Bandwidth reuse in cellular systems

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Unit V Linear time-invariant Gaussian channels: Single input multiple output (SIMO) channel, Multiple input single output (MISO) channel, Frequency-selective channel

Unit VI Capacity of fading channels: Slow fading channel, Receive diversity, Transmit diversity, Transmit and receive diversity, Time and frequency diversity, Outage for parallel channels, Fast fading channel, Transmitter side information, Frequency-selective fading channels

Unit VII Uplink and Downlink AWGN channel: Capacity via successive interference cancellation, Comparison with conventional CDMA, Comparison with orthogonal multiple access, General K-use ruplink capacity, Symmetric case: two capacity achieving schemes, General case: superposition coding achieves capacity

Unit VIII Uplink and Downlink fading channel: Slow fading channel, Fast fading channel, Full channel side information, Channel side information at receiver only, Full channel side information, Frequency selective fading channels

Unit IX Multiuser diversity: Multiuser diversity gain, Multiuser versus classical diversity, Fair scheduling and multiuser diversity, Channel prediction and feedback, Opportunistic beam forming using dumb antennas, Multiuser diversity in multicell systems

Unit X Physical Modeling of MIMO channels: Line-of-sight SIMO channel, Line-of-sight MISO channel, Antenna arrays with only a line-of-sight path, Geographically separated antennas, Line-of-sight plus one reflected path, MIMO multipath channel, Angular domain representation of signals, Angular domain representation of MIMO channels, Statistical modeling in the angular domain, Degrees of freedom and diversity, Dependency on antenna spacing.

Recommended Books

- Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
- David Tse, Pramod Viswanath, Fundamentals of Wireless Communications, Cambridge

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MTWC-102-18 INFORMATION THEORY & CODING	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

To enable students to understand information signals, coding and compression techniques and error detection and correction handling.

Course Outcomes

After the completion of the course, the student will be able to:

1. Understand the fundamentals of information theory
2. Encode text, audio, speech, image and video signals through various coding and compression techniques.
3. Detect and correct errors in the received signals through error detecting and correcting codes

Unit I Information Theory: Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit.

Unit II Source Coding: Text, Audio And Speech: Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MPEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

Unit III Source Coding: Image and Video: Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I, B, P frames, Motion estimation, Motion compensation, H.261, MPEG standard

Unit IV Error Control Coding: Block Codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes – Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC

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Unit V Error Control Coding: Convolutional Codes: Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

Recommended Books

- R Bose, Information Theory, Coding and Crptography, TMH 2007
- Fred Halsall, Multidedia Communications: Applications, Networks, Protocols and Standards, Perason Education Asia, 2002
- K Sayood, Introduction to Data Compression, 3rd Edition, Elsevier 2006
- S Gravano, Introduction to Error Control Codes, Oxford University Press 2007
- Amitabha Bhattacharya, Digital Communication, TMH 2006

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PROGRAM ELECTIVES - I

MTWC-PE1-18 WIRELESS SENSOR NETWORKS	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

To enable students familiarize with sensor networks, its constraints and protocols.

Course Outcomes

After the completion of the course, the student will be able to:

1. Gain insights of Wireless Sensor Network(WSN) background, its challenges, constraints along with its advantages and applications.
2. Know the architecture of WSN and its sub-systems.
3. Explain node structure along with the technologies used in WSN.
4. Study various Wireless Propagation Models and discuss the various MAC protocols, communication protocols and routing protocols.

Unit I Introduction: Introduction to Wireless sensor networks, Definitions and background, Challenges and constraints, Single-sink single-hop WSN, Single-sink multi-hop WSN, Multi-sink multi-hop WSN, Advantages of sensor networks.

Unit II Applications of WSNs: Positioning and animals tracking, Entertainment, Logistics, Transportation, Industrial Control and Monitoring, Home Automation and Consumer Electronics, Security and Military Sensing, Asset Tracking and Supply Chain Management, Intelligent Agriculture and Environmental monitoring, Health Monitoring.

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Unit III Node Structure: The Sensing Subsystem, Analog-to-Digital Converter, The Processor Subsystem, Architectural Overview, Microcontroller, Digital Signal Processor, Application-specific Integrated Circuit, Field Programmable Gate Array, Comparison Communication Interfaces, Serial Peripheral Interface, Inter-Integrated Circuit, Prototypes, The IMote Node Architecture, The XYZ Node Architecture, The Hogthrob Node Architecture
Unit IV Technologies for WSNs: ZigBee technology, Ultrawide bandwidth technology, Bluetooth technology, Comparison among technologies

Unit V
Physical Layer: Introduction, Wireless Propagation Models: The Free Space Propagation Model, The Two-Ray Ground Model, The Log-Distance Path Model, Energy Dissipation Model, Error Models: The Independent Error Model, The Two-State Markov Error Model, Sensing Models: The Binary Sensing Model, The Probabilistic Sensing Model

Unit VI Communication Protocols for WSNs: MAC protocols: Scheduled protocols, LEACH protocol, Guo protocol, TRAMA protocol, Contention-based protocols, Zhong protocol, DMAC protocol, PAMAS protocol, SMAC protocol.

Unit VII Routing Protocols: Issues in designing routing protocols, Classification of routing protocols, Flat routing, Flooding and gossiping, SPIN protocol, Directed diffusion protocol, Rumour routing, Gradient-based routing, Hierarchical routing, LEACH protocol, PEGASIS protocol, TEEN protocol, MECN protocol, SPAN protocol, Location-based routing protocols, GAF protocol, GEAR protocol, GeRaF protocol, Rugin protocol.

Recommended Books

- Kazem Sohraby, Daniel Minoli, TaiebZnati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley Inter Science
- Edgar H. Callaway, Wireless Sensor Networks: Architectures and Protocols, Jr. AuerbachPublications, CRC Press
- C. S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Wireless Sensor Networks, Springer
- Bhaskar Krismachari, Networking Wireless Sensors, Cambridge University Press
- Victor Lesser, Charles L. Ortiz, Milind Tambe, Distributed Sensor Networks: A MultiagentPerspective, Kluwer Publications

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- Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach,Morgan Kaufmann Series in Networking 2004
- Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: TheoryAnd Practice, John Wiley & Sons, August 2010

MTWC-PE1B-18	Credits	L	T	P	Internal	External
RF MEMS FOR WIRELESS COMMUNICATION SYSTEM	3	3	0	0	40	60

Course Objective

To familiarize students with circuits and circuit elements used in radio frequency MEMS wireless communication system.

Course Outcomes

After the completion of the course, the student will be able to:

1. Understand the key concepts in RF based MEMS wireless communication system
2. Design RF based circuits through modelling
3. Understand the usage of RF based circuit elements to reconfigure the circuit design
4. Study various oscillators and filters

Unit I Introduction: Spheres of wireless activities, the home and office, the ground fixed/mobile platform, the space platform, wireless standards, systems and architectures, wireless standards, conceptual wireless systems, wireless transceiver architectures, power and bandwidth-efficient wireless systems & challenges, MEMS based wireless appliances enable ubiquitous connectivity. Physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self resonance frequency, quality factor packaging, practical aspects of RF circuit design, dc biasing, impedance mismatch effects in RF MEMS.

Unit II Enabled Circuit Elements: RF/Microwave substrate properties, Micro machined – enhanced

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elements – capacitors, inductors, varactors, MEM switches – shunt MEM switch, low voltage hinged MEM switch approaches, push-pull series switch, folded – beam – springs suspension series switch.

Unit III Resonators & Enabled Circuits: transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustic wave resonators, MEMS modeling – mechanical modeling, electromagnetic modeling. Enabled circuits – reconfigurable circuits – the resonant MEMS switch, Capacitors, inductors, tunable CPW resonator, MEMS microswitch arrays.

Unit IV Reconfigurable Circuits: Double – stud tuner, Nth – stub tuner, filters, resonator tuning system, massively parallel switchable RF front ends, true time-delay digital phase shifters, Reconfigurable antennas – tunable dipole antennas, tunable microstrip patch-array antenna. Phase shifters fundamentals, X-Band RF MEMS Phase shifter for phased array applications, Ka-Band RF MEMS Phase shifter for radar systems applications.

Unit V Filters & Oscillators: Film bulk acoustic wave filters – FBAR filter fundamentals, FBAR filter for PCS applications, RF MEMS filters – A Ka-Band millimeter-wave Micromachined tunable filter, A High-Q8-MHz MEM Resonator filter, RF MEMS Oscillators – fundamentals, A 14-GHzMEM Oscillator, A Ka-Band Micromachined cavity oscillator, A 2.4 GHz MEMS based voltage controlled oscillator.

Recommended Books

- Hector J. De Los Santos, RF MEMS Circuit Design for Wireless Communications, Artech House,2002
- Vijay K. Varadan, K. J. Vinoy, K. A. Jose., RF MEMS and their Applications, John Wiley and sons, Ltd., 2002
- Gabriel M. Rebeiz, RF MEMS Theory, Design & Technology, Wiley Interscience, 2002

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MTWC-PE1C-18	Credits	L	T	P	Internal	External
ADVANCED DIGITAL SIGNAL PROCESSING	3	3	0	0	40	60

Course Objective

To understand the importance and usage of different signals, digital systems and processors.

Course Outcomes

After the completion of the course, the student will be able to:

1. Apply digital transform techniques on signals
2. Design digital FIR and IIR filters
3. Predict and estimate errors in digital signal processing systems
4. Handle multirate DSP and use adaptive filters

Unit I Review: Fourier Transforms, Z-Transforms, Discrete Fourier Transform, Fast Fourier Transform, Convolution and Correlation.

Unit II Design of digital filters: Introduction to filter design, types of digital filters,choosing between, FIR and IIR filters, filter design steps, effect of finite register length in filter design, realization of IIR digital filters and fir digital filter, design of IIR filters from continuous time filters, design of FIR filters by windowing.

Unit III Digital signal processors: General and special purpose digital signal processors, computerarchitecture for signal processing, selecting digital signal processors, architecture and programming of ADSP 2181 processor.

Unit IV Spectrum estimation: non-parametric methods correlation method, co-variance estimator,performance analysis of estimators, consistent estimators, AR, MA, ARMA signal modeling parameter estimation using Yule-walker method.

Unit V Linear estimation and predication: Maximum likelihood criterion efficiency of estimator,leastmean squared error criterion, recursive estimators, and linear predications.

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Unit VI Multirate digital signal processing: Mathematical description of change of sampling rate,interpolation and decimation, continuous time model, direct digital domain approach, interpolation anddecimation by an integer factor, single and multistage realization, applications of sub band coding.

Unit VII Adaptive Filters: Applications of Adaptive Filters, Adaptive Direct Form FIR Filters: The LMS Algorithm, Adaptive Lattice Ladder Filters, Recursive Least Squares Lattice Ladder Algorithms.

Recommended Books

- Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, NewYork, 1996
- Emmanuel C. Ifeachor Barrie W. Jervis, Digital Signal Processing, Pearson Education, Asia
- ProakesManolakis, Digital Signal Processing principles, algorithms, and applications, Prentice HallIndia
- ADSP 2181 manuals
- Keshab K. Parhi, VLSI DSP Systems; Design & implementation, Wiley Inter Science Publishers
- Moonen, Ian k. Proudler, Algorithms for statistic

MTWC-PE1D-18	Credits	L	T	P	Internal	External
AUDIO AND VIDEO SIGNAL PROCESSING	3	3	0	0	40	60

Course Objective

To inculcate in students the knowledge of audio and video signal generation, transmission, processing and reception.

Course Outcomes

After the completion of the course, the student will be able to:

1. Learn the audio and video signal processing systems.

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2. Code and decode the image, audio and video signals.
3. Modulate and demodulate digital signal processing systems.

Unit I: Limitation of natural reverberation by electronic devices, circuit solutions of Schroederre verberators based on DSP. Systems of audio signal processing for home theatres 3D sound, DolbyProLogic, Dolby Digital, DTS, THX, coding and decoding of audio signals.

Unit II: Systems of synthesis of natural and unnatural sounds, sound paradoxes. Properties, algorithms of computation, application of wavelet transform and wavelet systems to separate noise and undesirable components of audio signals and video signals. Methods a algorithms of preprocessing and postprocessing of images in spatial and frequency domain with application of discrete orthogonal 2Dtransformations.

Unit III: Modern methods of digital coding of images and video sequences entropic, predictive, transform, hybrid, hierarchical, sub band, wavelet. Intra frame and predictive interframe source coding of video sequences with movement estimation. Nonlinear and invariant transforms in applications of image processing and coding and movement estimation in video sequences.

Unit IV: International standardized codecs in systems DVB T,C,S a DVB H for mobile communication systems 31/2 a 4G. Methods of channel coding and decoding of digital video signals, digital modulations and demodulations in systems DVB T,C,S,H.

Recommended Books

- Branderburg K., Kahrs M., Applications of Digital Signal Processing to Audio and Acoustics, New York, Kluwer Academic Publishers, 2002
- Russ, M., Sound Synthesis and Sampling, Amsterdam, Focal Press, 2004
- Vaseghi S., Multimedia Signal Processing - Theory and Applications in Speech, Music and Communications, Chichester, England, John Wiley & Sons, 2007
- Zözler U., Digital Audio Signal Processing, Chichester, England, John Wiley & Sons, 2008
- Park T., Introduction to Digital Signal Processing Computer Musically Speaking, New Jersey, World Scientific Publishing Co., 2010.

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PROGRAM ELECTIVES - II

MTWC-PE2A-18	Credits	L	T	P	Internal	External
ADVANCED COMMUNICATION SYSTEM	3	3	0	0	40	60

Course Objective

To familiarize with the working of advanced communication systems.

Course Outcomes

After the completion of the course, the student will be able to:

1. Differentiate between analog and digital communication systems.
2. Transmit data through various digital modulation techniques.
3. Understand optical and satellite communication systems.
4. Recognize mobile communication systems, access techniques and transmission protocols.

UNIT-I Introduction: Conceptualized model of Digital Communication System (Description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidt Orthogonalization procedure. Geometric Interpretation of Signals, Response of Bank of Correlators to Noisy Input, M-ary orthogonal signals, Complex Signal space and Orthogonality, Energy of the Sum of Orthogonal Signals

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UNIT-II Band-limited channels: Pulse shaping for channels with ISI: Nyquist's First Criterion for Zero ISI, Partial response signaling (Duobinary and modified Duobinary pulses), detection of Duobinary Signaling, Maximum likelihood estimation technique.

UNIT-III Performance Analysis of Digital Communication Systems: Optimum Linear Detector for Binary Polar Signaling-Binary Threshold detection, Optimum Receiver Matched Filter, General Binary Signaling, Performance analysis of General Binary systems, Coherent Receivers for Digital Carrier Modulations, Signal Space Analysis of Optimum Detection, Vector Decomposition of White Noise Random Processes, Optimum Receiver for White Gaussian Noise Channels, Generalized Expression for Error Probability of Optimum Receivers.

UNIT-IV 4G Technology /OFDM: Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, BER performance over AWGN and Rayleigh fading, OFDM Issues like PAPR, Frequency and Timing Offset.

Recommended Books:

1. G. Proakis and M. Salehi, 'Fundamentals of Communication Systems', Pearson Education, 2005.
2. S. Haykins, 'Communication Systems', 5th Edn., John Wiley, 2008.
3. B.P.Lathi and Zhi Ding, 'Modern Digital and Analog Communication Systems, International Fourth Edition, Oxford University Press 2010.
4. S.Haykin, 'Digital Communication' Wiley-India, 2010

MTWC-PE2B-18	Credits	L	T	P	Internal	External
DETECTION AND ESTIMATION THEORY	3	3	0	0	40	60

Course Objective

To understand the different detection and estimation techniques for different signals.

Course Outcomes

After the completion of the course, the student will be able to:

1. Know the background of the signals, variables and processes.

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2. Test the data through statistical tools.
3. Learn the ways to detect non-parametric, random and deterministic signals.
4. Familiarize with the estimation of signal parameters

Unit I Background: Review of Gaussian variables and processes; problem formulation and objective ofsignal detection and signal parameter estimation in discrete-time domain.

Unit II Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihoodratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit III Detection of Deterministic Signals: Matched filter detector and its performance; generalizedmatched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

Unit IV Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection,detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit V Nonparametric Detection: Detection in the absence of complete statistical description ofobservations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

Unit VI Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher informationmatrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Unit VII Signal Estimation in Discrete-Time: Linear Bayesian estimation, Weiner filtering, dynamicalsignal model, discrete Kalman filtering.

Recommended Books

- H. L. Van Trees, Detection, Estimation and Modulation Theory: Part I, II, and III, John Wiley, NY, 1968

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- H. V. Poor, An Introduction to Signal Detection and Estimation, Springer, 2nd Edition, 1998
- S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall PTR, 1993

MTWC-PE2C-18	Credits	L	T	P	Internal	External
MOBILE ADHOC NETWORKS	3	3	0	0	40	60

Course Objective

To understand the working and protocol stack in mobile adhoc network.

Course Outcomes

After the completion of the course, the student will be able to:

1. Know the features, applications, models and characteristics of adhoc networks.
2. Learn the protocols followed in MAC layer, Network layer, Transport layer, Security layer and Cross layer design.
3. Learn how to integrate adhoc networks with mobile-IP networks.

Unit I Introduction: Introduction to adhoc networks–definition, characteristics features, applications,Characteristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models.

Unit II Medium Access Protocols MAC Protocols: design issues, goals and classification. Contentionbased protocols-with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Unit III Network Protocols: Routing Protocols: Design issues, goals and classification. Proactive Vsreactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

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Unit IV End-End Delivery and Security: Transport layer: Issues in desiging- Transport layerclassification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

Unit V Cross Layer Design and Integration of Adhocfor 4G: Cross layer Design: Need for crosslayer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Intergration of adhoc with Mobile IP networks.

Recommended Books

- C. Siva Ram Murthy, B. S. Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd Edition, Pearson Education, 2007
- Charles E. Perkins, Ad hoc Networking, Addison, Wesley, 2000
- Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic, Mobile Adhoc Networking, Wiley-IEEE Press, 2004
- Mohammad Ilyas, The handbook of Adhoc Wireless Networks, CRC press, 2002

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MTWC-PE2D-18	Credits	L	T	P	Internal	External
OPTICAL NETWORK AND PHOTONIC SWITCHING	3	3	0	0	40	60

Course Objective

To understand the communication process in optical networks and switching process.

Course Outcomes

After the completion of the course, the student will be able to:

1. Know the optical transmission and reception.
2. Apply the compensation techniques to the lost data/signals.
3. Learn the architecture and protocols of passive optical networks.
4. Learn the process of wire line techniques.

UNIT I Ray Theory Analysis & Transmission Characteristics: Fibre Optic Guides, Light wavegeneration systems, systems components, optical fibers, SI, GI fibre, modes, Dispersion in fibers limitations due to dispersions, fibre loss, non liner effects.

UNIT II Optical Transmitters & Receivers: Optical Transmitters and Fibres, Basic concept, spectraldistribution, semiconductor lasers, gain coefficients, modes. Transmitter design, Receive PIN and APD diodes,SNR. Switches, Coherent, homodyne and Hetro dyne keying formats, BER in synchronous and Asynchronous.

UNIT III Compensation Techniques: Amplifiers, Basic concepts, Semiconductor laser amplifiers Ramanand Brillouin-fibre amplifiers, Erbium doped-fibre and amplifiers, pumping phenomenon Dispersion Compensation Limitations, post and pre-compensation techniques, equalizing filters, SONET/SDH.

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UNIT IV Passive Optical Networks: Architectures And Protocols: PON Architectures,NetworkDimensioning and operation, Power Budget, FTTx , Broadband PON: architecture, protocol and Service, Bandwidth allocation. Gigabit-Capable PON. Burst switching, Ethernet PON Architecture, 10GEPON PMD Architecture.

UNIT V Wire Line Techniques: Wire line Narrowband, XDSL, Wire line broad band, Very High Bit RateDigital Subscriber Line (VDSL), Cable MODEM Home Networks, & VDSL Transmission Protocols. DOCSIS-Standards.

Recommended Books

- G. Keiser, Optical Communications Essentials, 1st Reprint, Tata McGraw Hill, 2008
- G. Keiser, Optical Fibre Communication System, McGraw Hill, New York, 2000
- J. M. Pitts & J. A. Schormans, Introduction to IP and ATM Design and Performance, 2nd Edition, Wiley, 2000
- G. P. Agarwal, Fibre Optic Communication System, 2nd Edition, John Wiley & b sons, New York 1997
- Franz, Jain, Optical Communication System, Narosa Publications, New Delhi, 1995
- Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw, David Gutierrez, Shing-Wa Wong, BroadbandOptical Access Networks, John Wiley and Sons, New Jersey, 2011

MTWC-111-18	Credits	L	T	P	Internal	External
WIRELESS COMMUNICATION LAB	2	0	0	4	40	60

Course Objective

This Laboratory will help the PG students to understand and design/Investigate Wireless channels, Fading environment and analyze their behavior.

Course Outcomes

1. To design Path-Loss models
2. To realize fading environments in wireless channels
3. To realize general modulation techniques

List of Experiments

1. Design Free-Space Propagation-Path Loss model to determine the free space loss and power received.
2. Realization of WLAN Multipath Channel to plot BER-SNR and Bit Rate -SNR graph for the fading environments of (i) No Fading (ii) Flat Fading
3. Realization of WLAN Multipath Channel to plot BER-SNR and Bit Rate -SNR graph for Dispersive Fading environment.
4. Implement Amplitude Modulation Techniques
5. Realize Frequency Modulation and Pulse Modulation.
6. Study the behavior of different filters.
7. Simulate MIMO channel and estimate BER and SNR .

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MTWC-112-18 INFORMATION THEORY & CODING LAB	Credits	L	T	P	Internal	External
	2	0	0	4	40	60

Course Objective

This Laboratory will help the PG students to understand and learn to implement programs for Information Theory and Coding.

Course Outcomes

1. To understand the programming of Entropies and Mutual Information

2. To learn and practice programming for generation and evaluation of various codes

3. To develop MATLAB codes for Block codes, Cyclic codes and Convolutional codes.

List of Experiments

1. Write a program for determination of various entropies and mutual information of a given channel.

2. Write a program for generation and evaluation of variable length source coding using C/MATLAB
a) Shannon – Fano coding and decoding
b) Huffman Coding and decoding
c) Lempel Ziv Coding and decoding

3. Write a Program for coding & decoding of Linear block codes.

4. Write a Program for coding & decoding of Cyclic codes.

5. Write a program for coding and decoding of convolutional codes.

6. Write a program for coding and decoding of BCH and RS codes.

7. Write a simulation program to implement source coding and channel coding for transmitting a text file.
More programs can be added as per the syllabus.

MTRM-101-18 RESEARCH METHODOLOGY & IPR	Credits	L	T	P	Internal	External
	2	2	0	0	40	60

Course Objective

To enable student to acquire knowledge of research process: gather data, implement the proposed work and collect the results and publish them.

Course Outcomes

After the completion of the course, students will be able to

1. Understand research, research process, define and redefine research problem through literature survey.
2. Know the primary and secondary sources of data collection and select sample size based on the requirement.
3. Utilize the resources efficiently.
4. Critically analyze the data through various statistical measures, perform experiment, gather data and reach to a conclusion based on some hypothesis.
5. Know the intellectual property rights.
6. Write up the report and research article.

Unit I Overview of Research: Meaning of Research, Objectives of research, Types of research, Research approaches, Significance of research, Criteria of good research. Defining the research problem: research problem, Necessity of defining the problem, Technique involve in defining a problem.

Unit II Research Design: Need for research design, Features of a good design, Basic principles of Experimental design Data Collection: Methods of Data Collection; Primary data and Secondary Data.

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Unit III Data preparation: Data preparation process, designing questionnaires and schedules. Descriptive statistics: Measures of central tendency, Mean,Median, Mode etc. Sampling and non-sampling errors, Testing of Hypotheses: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests.

Unit IV Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), Patents, Patent Law, Copyright, Trademarks, Geographical Indications, Industrial Design, Unfair Competition, Protection of IPR, Basic steps to write a research paper/ report writing, Introduction to Latex report writing, Introduction to Plagiarism.

Suggested Readings/ Books:

- Krishnaswami K. N., Sivakumar A. I., Mathirajan M., *Management Research Methodology*, Pearson Education, New Delhi
- Kothari C. R., Research Methodology Methods and Techniques, 2nd Edition, New Age International Publishers
- Halbert, Resisting Intellectual Property, Taylor & Francis Ltd ,2007.
- Niebel, Product Design, McGraw Hill.
- Asimov, Introduction to Design, Prentice Hall.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age.
- T. Ramappa, Intellectual Property Rights Under WT, S. Chand
- J.F.Kaiser, "Richard Hamming-You and Your Research", Transcription of Bell Communications Research Colloquium Seminar, 1986.

MTA101-18 Audit Courses -I

MTA1O1-18	Credits	L	T	P	Internal	External
Audit Course 1 English for research paper writing	Non-credit	0	0	0	S/US	S/US

Course Objective

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This course is to develop skills in effective English writing to communicate the research work

Course Outcomes

At the end of this course Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Unit 1

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit 5

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 6

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Recommended Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

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2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

MTA102-18						
Audit Course 1	Credits	L	T	P	Internal	External
Disaster Management	Non-credit	0	0	0	S/US	S/US

Course Objective

This course is to develop skills in helping society during natural disasters and how to manage.

Course Outcomes

At the end of this course students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Unit 1

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit 2

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Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Unit 4

Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 5

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit 6

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Recommended Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep & Deep Publication Pvt. Ltd., New Delhi.

MTA103-18	Credits	L	T	P	Internal	External
Audit Course 1 **Sanskrit For Technical Knowledge**	Non-credit	0	0	0	S/US	S/US

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Course Objective

This course is to develop

1. A working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes

At the end of this course students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

Unit 1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit 2

Order, Introduction of roots, Technical information about Sanskrit Literature.

Unit 3

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Recommended Books :

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTA104-18 Audit Course 1 **Value Education**	Credits	L	T	P	Internal	External
	Non-credit	0	0	0	S/US	S/US

Course Objective

This course is to develop

1. Value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes

At the end of this course students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgements.

Unit 2

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence,Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.

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Unit 3

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Unit 4

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

Recommended Books :

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

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Second Semester

MTWC-103-18 **ADVANCED WIRELESS COMMUNICATION**	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

To learn the fundamentals and advanced concepts in wireless communication.

Course Outcomes

After the completion of the course, the student will be able to:

1. Review the fundamentals of wireless communication.
2. Compare the performance of different digital modulation techniques over wireless channels.
3. Design OFDM system and data transmission through multicarrier modulation.
4. Describe OFDMA system, its operation and applications.

Unit I Review of Fundamentals of Wireless Communication: Multipath fading, multipath channel models, and capacity of wireless channels.

Unit II Performances of Digital Modulation over Wireless Channels: AGWN channels signal to noise power ratio and bit/symbol energy, error probability for BPSK, QPSK, MPSK, MPAM, MQAM- their comparison.

Unit III Multicarrier Modulation: Data transmission using multiple carriers, multicarrier modulation with overlapping sub channels, mitigation of subcarrier fading, discrete implementation of multicarrier modulation, challenges in multicarrier systems.

Unit IV Introduction to Wireless OFDM: OFDM principles, system model, generation of sub carrier using IFFT, guard time, cyclic extension, windowing, OFDM parameters, OFDM signal processing, coherent and differential detection

Unit V OFDMA: frequency hopping in OFDMA, difference between OFDMA and MC-CDMA, OFDMAsystem description-channel coding, frequency synchronization, initial modulation timing and frequency offset synchronization accuracy, random frequency hopping operation, applications of OFDMA.

Recommended Books

- Goldsmith, Wireless Communications, Cambridge Univ. Press, 2005
- R. Vannee, R. Prasad, OFDM for Wireless Multimedia Communication, Artech House, 2000
- M. Engels, Wireless OFDM systems, Klumer Academic Publishers, 2002

MTWC-104-18	Credits	L	T	P	Internal	External
SOFT COMPUTING TECHNIQUES	3	3	0	0	40	60

Course Objective

To enable the students utilize the soft computing techniques to optimize the systems.

Course Outcomes

After the completion of the course, the student will be able to:

1. Study basic concept of soft computing and differentiate between supervised, unsupervised and reinforced learning methods.
2. Learn various artificial neural network techniques, fuzzy sets, fuzzification and defuzzification.
3. Optimize solutions using Genetic Algorithm.

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4. Use hybrid soft computing techniques.

Unit I Artificial Neural Network: Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer, multilayer, competitive layer; Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent N.N; Application of N.N; Neuron. Pattern Recognition: Pattern Classification, Pattern Association, Clustering, Simple Clustering algorithm, k-means & k-medoid based algorithm. Models Of Neural Network: Architecture, Algorithm & Application of McCulloh-Pitts, Hebb Net, Perceptron (with limitations & Perceptron learning rule Convergence theorem), Back propagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet , Kohonen Self Organizing Maps, ART1, ART2.

Unit II Fuzzy Sets & Logic: Fuzzy versus Crisp; Fuzzy sets—membership function, linguistic variable,basic operators, properties; Fuzzy relations—Cartesian product, Operations on relations; Crisp logic— Laws of propositional logic, Inference; Predicate logic—Interpretations, Inference; Fuzzy logic— Quantifiers, Inference; Fuzzy Rule based system; Defuzzification methods; FAM

Unit III Genetic Algorithm: Basic concept; role of GA in optimization, Fitness function, Selection of initialpopulation, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Genetic Programming; Schema theorem; Multi objective & Multimodal optimization in GA; Application—Travelling Salesman Problem

Unit IV Hybrid soft computing Techniques: GA based BPNN(Weight determination, Application);Neuro Fuzzy Systems—Fuzzy BPNN--fuzzy Neuron, architecture, learning, application; Fuzzy Logic controlled G. A.

Recommended Books

- S. N. Sivanandam,S.N. Deepa, Principles of Soft Computing, Wiley India
- Simon Haykin, Neural Networks- A Comprehensive foundation, 2nd Edition Pearson

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- T. S. Rajasekaran, G. A. Vijaylakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms–Synthesis & applications, PHI
- Sanchez, Takanori, Zadeh, Genetic Algorithm & fuzzy Logic Systems, World Scientific
- Goldberg David E., Genetic Algorithm, Pearson
- Zimmermann H. J., Fuzzy Set Theory & Its Applications, Allied Publishers

MTWC-105-18	Credits	L	T	P	Internal	External
SIMULATION OF WIRELESS COMM. SYSTEMS	3	3	0	0	40	60

Course Objective
To inculcate in students the knowledge of simulation of real time wireless communication systems.

Course Outcomes
After the completion of the course, the student will be able to:
1. Study the role of simulation in communication system and random processes.
2. Review stochastic processes and parameter estimation.
3. Model wireless communication systems through numerical methods.
4. Study communication channel models and perform Monte Carlo Simulation.

Unit I Introduction to simulation approach: Methods of performance evaluation-simulation approach-Advantages and limitations. System model steps and its types involved in simulation study. Error sources in simulation. Role of simulation in communication system and random process. Introduction to random variables - univariate models (discrete and continuous) and multi-variate models.

Unit II Review of Stochastic process and parameter estimation: Stochastic process: Definitions,properties – stationarity, time averaging and ergodicity, random process models. Parameter estimation: Quality of an estimator, estimating average power probability density function, estimation of power spectral density of a process, delay and phase. SNR estimation and importance sampling.

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Unit III Numerical methods for wireless Communication Systems: numerical differentiation,integration, differential equation.

Unit IV Monte Carlo simulation: concepts and integration, Application in wireless CommunicationSystems.

Unit V Modelling of Communication systems: properties, generation and techniques for generatingrandom numbers and processes. Introduction to modeling of communication systems - Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.

Unit VI Communication channel models

Statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.

Recommended Books

- M. C. Jeruchim, Philip Balaban, K. Sam shanmugam, Simulation of communication systems, Plenum Press, New York, 1992
- M. Law, W. David Kelton, Simulation Modelling and analysis, McGraw Hill, New York, 1999
- K. Hayes, Modelling and Analysis of computer communication networks, Plenum press, New York, 1984
- Banks, J. S. Carson, Nelson, D. M. Nicol, Discrete–Event system simulation, Prentice Hall of India, 4^{th} Edition, 2005
- Z. Peebles , Probability, Random Variable and Random Signal Principles, Tata McGraw Hill, 4^{th} Edition 2007

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MTWC-105-18 WIRELESS COMMUNICATION SIMULATION LAB	Credits	L	T	P	Internal	External
	2	0	0	4	40	60

Course Objective

This Laboratory will help the PG students to understand and learn to implement programs related to Simulation of Wireless Communication.

Course Outcomes

1. To understand the programming of OFDM based Transmitter & Receiver.

2. To learn and practice MATLAB programming for implementing Digital modulation techniques.

3. To find the vacant spaces for secondary users in Cognitive Radio Networks..

List of experiments:

1. Develop MATLAB code to design OFDM based transmitter and receiver for different channel environment conditions.
2. Estimate and analyze the lifetime of 100 nodes in WSN using LEACH Protocol.
3. Develop MATLAB codes to Implement Digital Modulation techniques (i)ASK (ii) FSK (iii) M-PSK (iv) M-QAM (v)PCM.
4. Find the vacant spaces for Secondary Users in Cognitive Radio Network using Spectrum Sensing Techniques (i)Energy detection (ii)Matched Filter detection (iii) Cylostationary Detection.
5. Design OFDM System with 2x2, 2x4 and 4x4 MIMO System.

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MTWC-MP1-18	Credits	L	T	P	Internal	External
MINI PROJECT	2	0	0	4	40	60

Course Objective

To implement the knowledge gained during course practically.

Course Outcomes

After the completion of the course, the student will be able to:

1. Acquire practical knowledge of the chosen field.
2. Identify, analyze, formulate & handle programming projects with systematic approach.
3. Contribute as a team leader in the development of technical projects.
4. Develop communication skills for the presentation of project related activities.

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PROGRAM ELECTIVES - III

MTWC-PE3A-18	Credits	L	T	P	Internal	External
Smart Antennas	3	3	0	0	40	60

Course Objective

This Elective course is meant to recall the important concepts of Smart Antennas, their significance, applications and understand the behavior and working of Smart antennas with the help of the beam forming and other techniques.

Course Outcomes

After the completion of this course, the student will be able to:

1. Understand the significance of smart antennas and its historical development.
2. Know the architecture of Smart antennas, types, applications
3. Learn antenna array fundamentals criteria and beam forming basics.
4. Explain the Spatial Processing techniques for CDMA Smart Antennas.

Unit I Introduction to Smart Antennas: Why smart antennas, benefits of smart antennas, spatial processing for wireless systems, wideband smart antennas, historical development

Unit II Antenna Fundamentals: Antenna field regions, power density, radiation intensity, antenna nomenclature, friis transmission formula, linear antennas, loop antennas.

Unit III Array Fundamentals: Linear arrays, array weighting, circular arrays, rectangular arrays, fixed beam and retrodirective arrays.

Unit IV Beam Forming Basics: Maximum signal to interference ratio, minimum mean square ratio, minimum variance, adaptive beamforming, description of new SDMA receiver, software radios for smart antennas.

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Unit V Smart Antenna Techniques for CDMA: Non-coherent CDMA spatial processors, coherent CDMA spatial processors and the spatial processing rake receiver, multi-user spatial processing, dynamic re-sectoring using smart antennas, downlink beam forming for CDMA.

Recommended Books

- Gross F. B., Smart Antennas for Wireless Communications with MATLAB, McGraw-Hill, New York, 2005.
- Balanis A., Antenna Theory Analysis and Design, John Wiley and Sons, New York, 1982
- Joseph C. Liberti, Theodore S. Rappaport, Smart Antennas for Wireless Communications: IS95 and third generation CDMA Applications, Prentice Hall Communications Engineering and Emerging Technologies Series

MTWC-PE3B-18 Wireless Network Planning, Optimization and Management	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

This Elective course is meant to recall the important fundamentals of Wireless Network Planning, its significance, applications and understand their optimization and management.

Course Outcomes

After the completion of this course, the student will be able to:
1. Understand the Radio Network planning and optimization.
2. Know the technologies of WCDMA and GSM
3. Learn the fundamentals of Radio Resource Management

Unit I Introduction to Radio Network Planning and Optimisation - Future Trends -Towards a Service-driven Network Management - Wireless Local Area Networks (WLANs) - Next-generation Mobile Communication

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Unit II WCDMA Radio Network Planning: WCDMA Radio Network Planning: Dimensioning - Detailed Planning - Verification of Dimensioning with Static Simulations - Verification of Static Simulator with Dynamic Simulations - Optimisation of the Radio Network Plan.

UNIT III WCDMA–GSM Co-Planning Issues: WCDMA–GSM Co-planning Issues - Radio Frequency Issues – Radio Network Planning Issues; Coverage and Capacity Enhancement Methods - Techniques for Improving Coverage - Techniques for Improving Capacity

Unit IV Radio Resource Management: Radio Resource Utilisation: Introduction to Radio Resource Management - Power Control - Handover Control - Congestion Control – Resource Management; RRU for High-speed Downlink Packet Access (HSDPA) - Impact of Radio Resource Utilisation on Network Performance.

Unit V Radio Network Optimisation: Radio Network Optimisation Process - Introduction to Radio Network Optimisation Requirements - Introduction to the Telecom Management Network Model - Tools in Optimisation; Advanced Analysis Methods and Radio Access Network Autotuning - Advanced Analysis Methods for Cellular Networks - Automatic Optimisation.

Recommended Books

- Jaana Laiho, Achim Wacker, Tomas Novosad, Radio Network Planning and Optimisation, John Wiley, 2006
- Morten Tolstrup, Indoor Radio Planning: A Practical Guide for GSM, DCS, UMTS and HSPA, John Wiley, 2008
- IanaSiomina, Radio Network Planning and Resource Optimization, LiU-Tryck, Link¨oping, Sweden, 2007

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MTWC-PE3C-18 Microwave and RF Design	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

This Elective course is meant to recall the important fundamentals of the designs at Microwave and RF frequencies, its significance, applications and understand their technical concepts.

Course Outcomes

After the completion of this course, the student will be able to:
1. Understand the significance of Microwave and RF designs.
2. Know the fundamentals behind Microwave Amplifiers/Oscillators designs
3. Technical know-how of Microwave and RF antennas concepts

Unit I Networks and Matrices: Scattering and chain scattering matrices, Generalized scattering matrix, Analysis of two port networks, Interconnection of networks. Positive real concepts, scattering matrix, representation of microwave components (directional coupler, circulators, hybrids and isolators).

Unit II High Frequency Circuit Design: Tuned Circuits, Filter design- Butterworth filter, Chebyshev filter, impedance matching. High frequency amplifier, BJT and FET amplifier, Broadband Amplifiers RF Oscillators, Colpitts, Hartley Oscillators, PLL. High Frequency Integrated Circuits.

Unit III Microwave Amplifier Design: Types of amplifiers, Power gain equations. Introduction to narrow band amplifiers basic concepts, Maximum gain design, Low noise design. High power design, Negative resistance, reflection amplifiers – various kinds – stability considerations, Microwave transistor amplifier design – input and output matching networks – constant noise figure circuits.

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Unit IV Microwave Transistor Oscillator Design: One port and two port negative resistance oscillators. Oscillator configurations, Oscillator design using large signal measurements, Introduction to Microwave CAD packages, Microwave integrated circuits, MIC design for lumped elements.

Unit V RF and Microwave Antennas: Radiation from surface current and line current distribution, Basic Antenna parameters, Feeding structure-Patch Antenna, Ring Antenna, Micro strip dipole, Micro strip arrays, Traveling wave Antenna, Antenna System for Mobile Radio-Antenna Measurements and Instrumentation. Propagation characteristics of RF and Microwave signals, Introduction to EBG structures.

Recommended Books

- Matthew M. Radmanesh, RF and Microwave Design Essentials, Author House, Bloomington, 2007
- Daniel Dobkin, RF Engineering for Wireless Networks, Elsevier, London, 2005
- Reinhold Ludwig, Gene Bogdanov, RF Circuit Design – Theory and Applications, 2nd Edition, Pearson, 2012
- E.da Silva, High Frequency and Microwave Engineering, Butterworth Heinmann Publications, Oxford, 2001.
- David M. Pozar, Microwave Engineering, John Wiley and Sons,3rd Edition, 2005
- Kraus J. D, Marhefka. R. J. Khan A. S. Antennas for All Applications, 3rd Edition, Tata McGraw Hill, 2006
- Balanis A, Antenna Theory Analysis and Design, John Wiley and Sons, New York, Third Edition, 2005

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MTWC-PE3D-18	Credits	L	T	P	Internal	External
Multimedia Communication and Technology	3	3	0	0	40	60

Course Objective

This Elective course is meant to recall the important fundamentals of the designs at Microwave and RF frequencies, its significance, applications and understand their technical concepts.

Course Outcomes

After the completion of this course, the student will be able to:
1. Understand the fundamentals of multimedia system design..
2. Apply compression and decompression techniques to image, audio and video signals.
3. Differentiate between various multimedia input-output technologies and storage-retrieval technologies.
4. Learn the design aspects of multimedia applications

Unit I Multimedia Communication: An Introduction: Multimedia Information representation, Multimedia Networks: Telephone Network, Data Network, Broadcast Network etc, Multimedia Applications: Interpersonal communications, Entertainment applications etc, Application and Networking: Media Types, Network types etc, Technology of Multimedia.

Unit II Multimedia Information Representation: Introduction, Digitization principles: Analog Signals, Encoder design, Decoder Design, Text: Unformatted Text, Formatted text, Images: Graphics, Digitized documents etc, Audio: PCM speech, CD-quality audio, Video: Broadcast television.

Unit III Multimedia Compression (Text and Image): Introduction, Multimedia compression principles: Source encoders and destination decoders, Lossless and lossy compression, Entropy encoding, Source encoding, Text Compression: Static Huffman coding, Dynamic Huffman coding, Image compression: GIF, TIFF etc,

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Unit IV Multimedia Compression (Audio and Video): Audio Compression: Differential pulse code modulation, Linear predictive coding MPEG audio coders etc, Video Compression: Video compression principles, H.261, MPEG etc. Recent trends in Multimedia communication.

Recommended Books

- Andleigh P. K., Thakrar K., Multimedia Systems, Addison Wesley Longman, 1999
- Fred Halsall, Multimedia Communications, Pearson Education, 2000
- Ralf Steinmetz, Klara Nahrstedt, Multimedia, Computing, Communications and Applications, Prentice Hall, 1995
- Tay Vaughan, Multimedia making It work, TMH, 5th Edition 2001
- Weixel, Fulton, Barksdale.Morse, Multimedia Basics, Easwar Press, 2004

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PROGRAM ELECTIVES - IV

MTWC-PE4A-18	Credits	L	T	P	Internal	External
Cryptography and Wireless Security	3	3	0	0	40	60

Course Objective

This is one of the Elective courses that is meant to understand the important concepts of Cryptography, its mathematical formulation, applications, Authentication and system security techniques.

Course Outcomes

After the completion of this course, the student will be able to:
1. Understand the significance of Cryptography
2. Know its Integrity, Authentication and Management
3. Learn the concepts of Security and threats to wireless systems.

Unit I Number Theory and Cryptography: Mathematics of cryptography - integer arithmetic, modular arithmetic, linear congruence, GF (2n), algebraic structures, primes, Euler's phi & totient functions, Fermat"s and Euler"s theorem, primality testing, factorization, CRT, quadratic congruence, exponentiation and logarithm, elliptic curve cryptosystem, symmetric key cryptography - substitution, transposition, modern block ciphers, and its applications.

Unit II Integrity, Authentication and Key Management: Introduction to message integrity, hash functions and digital signature, SHA-512, MAC & MDC, HMAC, CMAC, digital signature- DSA,ECDSA, Entity

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authentication-passwords, challenge-response, zero-knowledge, key management-PKI, symmetric key agreement, RSA ,ElGammal, information theory, and elementary probability, complexity of algorithm.

Unit III Security Practice & System Security: Electronic Mail Security – PGP, S/MIME, IPSec, Secure Electronic Transaction, web security considerations – SSL, TLS, IDS-password management, viruses and related threats, viruses counter measures, firewalls design principles, types of firewalls, configurations, trusted systems.

Unit IV Wireless Threats: Introduction to wireless technologies- history, challenges, risks, advances in wireless security, Radio Frequency –RF Terminology, interference, covert channels, and hardware. Hacking 802.11 wireless technologies- eavesdropping, jamming - wireless channel vulnerability analysis, Wi-Fi cyber crimes and awareness- countermeasures - wireless security standards wireless setup, risks and security controls.

Unit V Wireless Security: 802.11i - Attacks, WPA-EAP, Attacking 802.11 Networks- Basic Types Of Attacks, Security Through Obscurity, Defeating WEP, WEP attacks, 802.11 Authentication Types, Attacking WPA-Protected 802.11, Breaking WPA, LEAP,EAP-TLS, Tunneling EAP Techniques, Hacking Attacking 802.11i wireless technologies- Hacking hotspots, client attacks resources, threats of Bluetooth- advanced attacks- layer 2 fragmentations breaking the silence, layer 2 and layer 3 resolutions.

Recommended Books

- Behrouz Forouzan, Cryptography & Network Security, Tata McGraw Hill, 2008
- Johnny Cache, Vincent Liu, Hacking Exposed Wireless: Wireless Security secrets And Solutions, Tata McGraw Hill, 2007
- William Stallings, Cryptography & Network Security – Principles and Practices, Pearson Education, Fourth Edition, 2006
- Doughas R. Stinson, Cryptography-Theory and Practice, CRC Press,1995
- Wolfgang Osterhage, Wireless Security, CRC Press, 2011

- Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Cengage Learning, 4th Edition, 2011

MTWC-PE4B-18	Credits	L	T	P	Internal	External
Software Defined radios and Cognitive Radio	3	3	0	0	40	60

Course Objective

This is an interesting Elective course that is meant to understand the important concepts of Software defined Radios (SDR) as well as Cognitive radios, their significance, implementation and applications.

Course Outcomes

After the completion of this course, the student will be able to:
1. Learn Software Defined Radio concepts, architecture and SDR based end-to -end communication.
2. Understand communication setup between client and server through CORBA.
3. Apply SDR principles to smart antenna
4. Know the importance of frequency reuse through Cognitive Radio. Locate vacant spaces in spectrum through spectrum sensing techniques.

Unit I SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA. Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems.

Unit II Common Object Request Broker Architecture (CORBA), SCA and JTRS compliance, Radio Frequency design, Baseband Signal Processing, Radios with intelligence.

Unit III Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures, Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio.

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Unit IV Cognitive Radio, concepts & history, frequency spectrum allocation, vacant spectrum sensing techniques. Efficient utilization of vacant holes in cognitive radio networks

Recommended Books

- Dillinger, Madani, Alonistioti (Eds.), Software Defined Radio, Architectures, Systems and Functions, Wiley, 2003
- Reed, Software Radio, Pearson
- Paul Burns, Software Defined Radio for 3G, 2002
- Tafazolli (Ed.), Technologies for the Wireless Future, Wiley 2005
- Bard, Kovarik, Software Defined Radio, the Software Communications Architecture, Wiley, 2007

MTWC-PE4C-18	Credits	L	T	P	Internal	External
Wireless and Optical Communication Networks	3	3	0	0	40	60

Course Objective

This is an interesting Elective course that is meant to understand the important concepts of Wireless as well as Optical Communication networks, their significance, network components applications.

Course Outcomes

After the completion of this course, the student will be able to:

1. Learn Wireless Communication Network layers/technology .
2. Understand basic network components of Wireless and Optical Networks.

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3. Explain their applications

4. Know the importance of frequency reuse through Cognitive Radio. Locate vacant spaces in spectrum through spectrum sensing techniques.

Unit I Wireless Communication Networks: 3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture - Introduction to wireless LANs -IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

Unit II MIMO Communication: Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

Unit III Optical Communication networks: Introduction: circuit switching and packet switching, optical layer, network evolution. Optical networking components/building blocks: Optical fibers, Optical transmitter, receiver and filters, multiplexers, switching elements, wavelength converter, and optical amplifiers. Client layers of the optical layer, WDM network elements. Optical switching: Packet switching, burst switching, MEMs based switching.

Unit IV Optical Metro Network: SONET/SDH, Fault management in SONET/SDH. Optical Access Network: Access networks, Photonic packet switching. Deployment considerations. Overview of PON technologies, Ethernet access network, WDM-PON. Control and management, network survivability, protection schemes.

Recommended Books

- Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
- HARRY R. ANDERSON, "Fixed Broadband Wireless System Design" John Wiley – India, 2003.
- Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
- Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.

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- Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
- John M. senior, 'Optical fiber communication,' PHI
- G.E. Keiser, 'Optical fiber communication,' McGraw Hill
- P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ

MTWC-PE4D-18	Credits	L	T	P	Internal	External
MIMO Systems	3	3	0	0	40	60

Course Objective

The purpose of the course is to provide a comprehensive coverage of coding techniques for multiple-input, multiple-output (MIMO) communication systems.

Course Outcomes

After completing this course the student will be able to:

1. Understand Basic MIMO communication systems
2. Explore Space-time block codes & Space-time trellis codes
3. MIMO systems for frequency-selective (FS) fading channels

Unit I FADING CHANNEL AND DIVERSITY TECHNIQUES: Wireless channels – Error/Outage probability over fading channels – Diversity techniques – Channel coding as a means of time diversity – Multiple antennas in wireless communications.

Unit II CAPACITY AND INFORMATION RATES OF MIMO CHANNELS: Capacity and Information rates of noisy, AWGN and fading channels – Capacity of MIMO channels – Capacity of non-coherent MIMO channels – Constrained signaling for MIMO communications.

Unit III SPACE TIME BLOCK AND TRELLIS CODES: Transmit diversity with two antennas: The Alamouti scheme – Orthogonal and Quasi-orthogonal spacetime block codes – Linear dispersion codes – Generic

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space-time trellis codes – Basic space-time code design principles – Representation of space-time trellis codes for PSK constellation – Performance analysis for space-time trellis codes – Comparison of space-time block and trellis

Unit IV FREQUENCY SELECTIVE FADING CHANNELS MIMO: frequency-selective channels – Capacity and Information rates of MIMO FS fading channels – Space - time coding and Channel detection for MIMO FS channels – MIMO OFDM systems.

Recommended Books

- Tolga M. Duman and Ali Ghrayeb, "Coding for MIMO Communication systems", John Wiley & Sons, West Sussex, England, 2007.
- A.B. Gershman and N.D. Sidiropoulus, "Space-time processing for MIMO communications", Wiley, Hoboken, NJ, USA, 2005.
- E.G. Larsson and P. Stoica, "Space-time block coding for Wireless communications", Cambridge University Press, 2003.
- M. Janakiraman, "Space-time codes and MIMO systems", Artech House, 2004.
- H. Jafarkhani, "Space-time coding: Theory & Practice", Cambridge University Press, 2005.

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MTAXX-18 Audit Courses II

MTA105-18	Credits	L	T	P	Internal	External
Audit Course 2 Constitution of India	Non-credit	0	0	0	S/US	S/US

Course Objective

This course is to

1. Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

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Unit 1:

History of Making of the Indian Constitution:History, Drafting Committee, (Composition & Working).

Unit 2:

Philosophy of the Indian Constitution:Preamble, Salient Features.

Unit 3:

Contours of Constitutional Rights & Duties:Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State PolicyFundamental Duties.

Unit 4:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Unit 5:

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: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials,Importance of grass root democracy.

Unit 6:

Election Commission:Election Commission: Role and Functioning, Chief Election, Commissioner and Election Commissioners, State Election Commission: Role and Functioning,Institute and Bodies for the welfare of SC/ST/OBC and women.

Recommended Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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MTA106-18 Audit Course 2 **Pedagogy Studies**	Credits	L	T	P	Internal	External
	Non-credit	0	0	0	S/US	S/US

Course Objective

This course is to inculcate better teaching methods/tools for future teachers to build a better education system to compete with the developed nations pedagogical practices

Course Outcomes

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Unit 1:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Unit 2:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit 3:

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Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included, studies, How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence foreffective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4:

Professional development: alignment with classroom practices and follow-up support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit 5:

Research gaps and future directions- Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Recommended Books :

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

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MTA107-18	Credits	L	T	P	Internal	External
Audit Course 2 **Stress Management By Yoga**	Non-credit	0	0	0	S/US	S/US

Course Objective

This course helps to achieve overall health of body and mind and overcome stress

Course Outcomes

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Unit 1:

Definitions of Eight parts of yog. (Ashtanga)

Unit 2:

Yam and Niyam, Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit 3:

Asan and Pranayam, i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam.

Recommended Books:

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1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama(Publication Department), Kolkata

MTA108-18	Credits	L	T	P	Internal	External
Audit Course 2 Personality Development Through Life Enlightenment Skills	Non-credit	0	0	0	S/US	S/US

Course Objective

This course helps to learn toachieve the highest goal happily, become a person with stable mind, pleasing personality and determination and awaken wisdom in students

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Unit 1:

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's).

Unit 2:

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Approach to day to day work and duties, Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.

Unit 3:

Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63.

Recommended Books :

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya SanskritSansthanam, New Delhi.

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THIRD SEMESTE

PROGRAM ELECTIVES - V

MTWC-PE5A-18	Credits	L	T	P	Internal	External
Millimeter Wave Communication and Technology	3	3	0	0	40	60

Course Objective

This is one of the Elective courses that is meant to understand the important concepts of MM Wave Communication & Technology, its characteristice, standards, applications.

Course Outcomes

After the completion of this course, the student will be able to:

1. Learn millimetre wave characteristics, standards and applications.
2. Recognize design considerations for millimetre wave antenna, concepts of beamforming and beam steering.
3. Learn modulation techniques used in transceiver design and link budget.
4. Explain MIMO system for millimetre wave communication.

Unit I Multi Gigabit 60-GHz Millimeter Wave Radios: Millimeter wave characteristics-Channel performance at 60GHz, Gigabit wireless communication, Comparison of Three Technologies for Gigabit Wireless Communications, Possible Applications for Millimeter Wave Communications, Coexistence with wireless backhaul.

Unit II Millimeter Wave Transceivers: Millimeter wave link budget, 60 GHz transmitter, receiver, and wireless link, Modulation techniques-OOK, PSK, FSK, QAM, OFDM.

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Unit III Advanced Beam Steering and Beam Forming: Need for beam steering and beam forming, Beam steering of a narrow-beam antenna having a main antenna radiation pattern, System model of phase array antennas,

UNIT IV Adaptive frame structure: Frame structure to enable beam steering or beam forming, Channel sounding frame and data frame, Adaptive frame structure to reduce the CSF overhead, Long data frame and short data frame, Advanced beam steering technology, Acquisition and tracking algorithm for beam steering, Flowchart of beam steering algorithm, Advanced beam forming technology, Advanced antenna ID technology.

Unit V Millimeter Wave MIMO: Spatial diversity of antenna arrays, Multiple antennas, Multiple transceivers.

Recommended Books

- Kao-Cheng Huang, Zhaocheng Wang, *Millimeter wave communication systems,* John Wiley & Sons, Hoboken, New Jersey, 2011
- Jonathan Wells, *Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications,* Artech House, 2010
- Su-Khiong Yong, Pengfei Xia, Alberto Valdes-Garcia, *60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice*, Wiley 2010

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MTWC-PE5B-18 Space Time Wireless Communication	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

This is one of the Elective courses that is meant to understand the important concepts of Space time Wireless Communication, Channel, Multiple Antenna Propagation, Capacity and Space diversity.

Course Outcomes

After the completion of this course, the student will be able to:

1. Understand Space Time Channel Characterization
2. Explain Capacity of Multiple Antenna Channels
3. Learn ST OFDM, Spread Spectrum

Unit I Multiple Antenna Propagation and ST Channel Characterization: Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.

Unit II Capacity of Multiple Antenna Channels: Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

Unit III Spatial Diversity: Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.

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Unit IV Multiple Antenna Coding and Receivers: Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers (SISO, SIMO, MIMO), Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

Unit V OFDM, Spread Spectrum and MIMO Multiuser Detection: SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO- OFDM,SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO- S.MIMO-MAC,MIMO-BC, Outage performance for MIMO-MU,MIMO-MU with OFDM,CDMA and multiple antennas.

Recommended Books

- Paulraj, Rohit Nabar, Dhananjay Gore, *Introduction to Space Time Wireless Communication Systems*, Cambridge University Press, 2003
- Sergio Verdu, *Multi User Detection*, Cambridge University Press, 1998
- Andre Viterbi, *Principles of Spread Spectrum Techniques*, Addison Wesley 1995

MTWC-PE5C-18	Credits	L	T	P	Internal	External
Advanced Techniques for Wireless Reception	3	3	0	0	40	60

Course Objective

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This Elective course is meant to explore the important concepts of Wireless Reception taking due consideration on Wireless signaling environment, Multiuser detection, CDMA, OFDM, MIMO Systems

Course Outcomes

After the completion of this course, the student will be able to:

1. Understand Wireless Signaling Environment
2. Explain the usage of Multiuser detection
3. Learn CDMA, OFDM, MIMO systems

Unit I: Wireless signaling environment, Basic signal processing for wireless reception. Linear receivers for synchronous CDMA. Blind and group-blind multiuser detection methods.

Unit II: Robust multiuser detection for non Gaussian channels; asymptotic performance. Adaptive array processing in TDMA systems. Optimum space-time multiuser detection.

Unit III: CDMA- Encoder and decoder, difference between IS-95 and WCDMA, RAKE receiver- basic idea, propagation of transmitted signal, multipath, applications of RAKE receiver.

Unit IV: OFDM system and principle, multicarrier modulation, guard interval and inter symbol interference, cyclic prefix, equalization, advantages and disadvantages.

Unit V: MIMO multi input multi output, history, wireless channel and its characteristics, capacity of MIMO system, MIMO design criterion, diversity, space time for wireless communication, variants of multiple antenna system.

Recommended Books

- X. Wang, H. V. Poor, Wireless Communication Systems, Pearson, 2004
- R. Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001
- Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press, 2005

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- V. H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications, 2004
- Paulraj, Introduction to Space-time Wireless Communications, Cambridge University Press, 2003

MTWC-PE5D-18 Emerging Technologies of Wireless Communication	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

This Elective course is meant to explore the important concepts of Wireless Communication and its emerging technologies like GPRS, UMTS, WiFi, WiMAX, UWB, CDMA, OFDM, MIMO Systems

Course Outcomes

After the completion of this course, the student will be able to:
1. Understand the concept of cellular/wireless communication
2. Explain the Mobile Radio Propagation and Multiuser systems
3. Learn technologies of GPRS, UMTS, WiFi, WiMAX, Ultra Wideband communications, 4G and beyond 4G

Unit I Introduction to Wireless Communication: The Cellular concept, System design, Capacity improvement in cellular systems, Co channel interference reduction. Intelligent cell concept and applications. Technical Challenges.

Unit II Mobile Radio Propagation: Reflection, Diffraction. Fading. Multipath Propagation. Channel modeling, Diversity Schemes and Combining Techniques. Design parameters at the base station, Practical link budget design using path loss models. Smart antenna systems, Beam forming. MIMO Systems. RAKE receiver.

Unit III Multiuser Systems: CDMA- Principle, Network design, Link capacity, Power control, CDMA Network planning, MC-CDMA, OFDM.

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Unit IV Cellular mobile communication beyond 3G: GSM, IS-95, GPRS, UMTS, WiFi, WiMAX, Ultra Wideband communications, 4G and beyond 4G.

Recommended Books

- F. Molisch, Wireless Communications, Wiley, 2005
- Goldsmith, Wireless Communications, Cambridge University Press, 2005
- P. Muthu Chidambara Nathan, Wireless Communications, PHI, 2008
- Ke-Lin Du, M. N. S. Swamy, Wireless Communication Systems", Cambridge University Press, 2010
- K. Fazel, S. Kaiser, Multi-carrier and Spread Spectrum Systems, Wiley, 2003
- S.G. Glisic, Advanced Wireless Communications, 4G Technologies, Wiley, 2004
- W. C. Y.Lee, Mobile Communication Engineering, 2nd Edition, McGraw- Hill, 1998.
- S.G. Glisic, Adaptive CDMA, Wiley, 2003

MTWC-PE5E-18	Credits	L	T	P	Internal	External
Microstrip Antennas	3	3	0	0	40	60

Course Objective

This Elective course is meant to explore the important concepts of Micro-strip Antenna systems, methods to analyze them, their configurations, applications.

Course Outcomes

After the completion of this course, the student will be able to:

1. Understand the basic concept of micro-strip antennas, methods of analysis and configurations.
2. Explain micro-strip antennas arrays.
3. Understand the physical significance of discontinuities.
4. Learn coupled micro-strip line with multiband and broadband behavior.

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UNIT I - Micro-Strip Lines: Introduction of Planar Transmission Structures, Micro-strip Field Configuration, Micro-strip Dispersion Models, Micro-strip Transitions, Micro-strip measurement, Methods of Full wave Analysis, Analysis of an Open Micro-strip, Analysis of an Enclosed Micro strip, Design Considerations, Suspended and Inverted Micro-strip Lines, Multilayered Dielectric Micro-strip, Thin Film Micro-strip (TFM), Valley Micro-strip Lines, Micro-strip Applications.

UNIT II - Micro-Strip Antenna Arrays: Array theory, Array calculations and analysis, array architectures, corporate array design, Resonant series fed array design, Series fed traveling wave array design. Micro-Strip Discontinuities: Introduction of Quasi-Static Analysis and Characterization, Discontinuity Capacitance Evaluation, Discontinuity Inductance Evaluation, Characterization of Various Discontinuities, Planar Waveguide Analysis, Full wave Analysis of Discontinuities, Discontinuity Measurements.

UNIT III - Slot-Line: Introduction of Slot-lines, Slot-line Analysis, Design Considerations, Slot-line Discontinuities, Slot-line Transitions, Slot-line Applications. Coplanar Lines and Wave Guides: Introduction of Coplanar Waveguide and Coplanar Strips, Quasi-Static Analysis, Design Considerations, Losses, Effect of Tolerances, Comparison with Micro-strip Line and Slot-line, Transitions, Discontinuities in Coplanar Waveguide, Coplanar Line Circuits.

UNIT IV - Coupled Micro-Strip Lines: Introduction of Coupled Micro-strip Lines, General Analysis of Coupled Lines, Characteristics of Coupled Micro-strip Lines, Measurements on Coupled Microstrip Lines, Design Considerations for Coupled Micro-strip Lines, Coupled Multi conductor Micro-strip Lines, Discontinuities in Coupled Micro-strip Lines. Micro-Strip Circuit Design: impedance transformers, filters, isolators and phase shifters.

Recommended Books

- Gupta, K.C. and Garg, Ramesh, Micro-strip lines and slot lines, Artech house (1996).
- Sainiti, Robert A., CAD of Micro-strip Antenna for Wireless Applications, Artech House (1996).
- Lu, Wong Kim, Planar antennas for Wireless applications, John Wiley and Sons (2003).
- Simons, Rainee N., Coplanar Waveguide Circuits, Components, and Systems, John Wiley and Sons (2001).

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MTOE-301X-18 Open Electives

MTOE-301A-18 Open Elective Cost Management of Engineering Projects	Credits	L	T	P	Internal	External
	3	3	0	0	40	60

Course Objective

This is course deals with strategic cost management for engineering projects and useful quantitative techniques to implement

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the cost calculation for decision-making about an engineering research project
2. Able to define Role of each member in the project team
3. Manage the project by applying Quantitative techniques for cost management

Unit 1

Introduction and Overview of the Strategic Cost Management Process

Unit 2:

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

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Unit 3:

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit 4:

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Recommended Books :

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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MTOE-301B-18	Credits	L	T	P	Internal	External
Open Elective Composite Materials	3	3	0	0	40	60

Course Objective

This is course deals with Composite Materials and preparation/manufacturing of Metal Matrix Composites

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the characteristics of Composite materials and their advantages and applications
2. Get exposure to Manufacturing of Metal Matrix Composites: Knitting, Braiding, Weaving and estimate Strength

Unit 1

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2:

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostressconditions.

Unit 3:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications

Unit 5:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insightstrength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Recommended Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-301C-18	Credits	L	T	P	Internal	External
Open Elective Waste to Energy	3	3	0	0	40	60

Course Objective

This is course deals with effective and cheap methods to convert waste into useful energy.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand various methods to convert agro, forest and industrial residue to useful energy
2. Get exposure Biomass Combustion, Biomass Gasification etc.

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Unit 1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit 2:

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit 3:

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kineticconsideration in gasifier operation.

Unit 4:

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design,construction and operation - Operation of all the above biomass combustors.

Unit 5:

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications – Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

Recommended Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill
3. Publishing Co. Ltd., 1983.
4. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
5. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

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MTWC-DS1-18	Credits	L	T	P	Internal	External
DISSERTATION PHASE I	10	0	0	20	60	40

Course Objectives: To prepare the students to develop research expertise and knowledge in the area of particular interest.

Course Outcomes: After the completion of the course, the student will be able to:

1. Critically analyse and evaluate existing knowledge about the chosen problem.
2. Find the gaps and motivation through literature survey.
3. Design the framework to optimize the solution for the problem.
4. Construct the research proposal.

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FOURTH SEMESTER

(2)

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MTWC-DS2-18	Credits	L	T	P	Internal	External
DISSERTATION PHASE II	**16**	**6**	**0**	**20**	**60**	**40**

Course Objective: To enable the student to implement the proposed research work and publish their authentic results.

Course Outcomes: After the completion of the course, the student will be able to:

1. Implement the proposed framework practically or through simulation.
2. Gather the results and publish in the research articles.
3. Write-up the proposed work, results with conclusion and future work in the form of thesis.
4. Present the research work before a committee.

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I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/N/ *Dated :*

NOTIFICATION

Sub: **Regarding Pre-Ph.D Course work.**

This is for information of all concerned that Pre-Ph.D course work from 2016-17 will be conducted in the IKGPTU main campus Kapurthala in regular mode. The PhD course work will consists of minimum 15 credits. The structure of the course work is as under.

Sr. No.	Nature of course	Name of course	Credits	Remarks
1.	Core	1.Research Methodology	4	The syllabus of RM should be formulated faculty wise such as Engineering, Science, Management/ Humanities and Life sciences
		2.Subject related theory paper	4	Discipline specific related to advancements in theoretical methods for research
		3. Presentation	3	Discipline specific
2.	Interdisciplinary	4. Elective	4	From list of subjects from allied fields
	Total Minimum credits		**15**	

-Sd-
Registrar

Endorsement No: IKGPTU/REG/N/ 4244-4251 Dated: 22.08.2016

1. Secretary to Vice Chancellor: For kind information of Vice Chancellor
2. Dean (P&D)
3. Dean (RIC)
4. Dean (Academics)
5. Finance Officer
6. Controller of Examination
7. DR (Computers): For uploading on website
8. File Copy

Registrar 1/8/16

I. K. Gujral Punjab Technical University, Jalandhar
Jalandhar Kapurthala Highway, Near Pushpa Gujral Science City, Kapurthala - 144 603
Ph. No. 01822 - 662521, 662501 Fax No. : 01822-255506, 662526, Email : registrar@ptu.ac.in

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Pre Ph.D. Course in Electronics and Communication Engineering
Schematic and Syllabus

Sr. no.	Nature of Course	Name of course	Credits	Remarks
1.	Core	Research Methodology	4	The syllabus of RM should be formulated faculty wise
		Discipline Specific subjects	4	1.Advanced Wireless Communication 2.Advanced Communication Systems 3.Advanced Digital Signal processing 4.Real time concepts for Embedded systems 5. Radiating systems 6. Microwave and Millimeter wave circuits 7. RF & Microwave System Design 8. Image and Video Processing 9. Bio-Medical Signal Processing 10. MOS Circuit Design 11. Low Power VLSI Circuits 12. Advanced Data Communication 13. Coding Theory and Techniques 14. Optical Communication Technology 15. Optical Networks.
		Presentation	3	Discipline specific
2.	Interdisciplinary	Elective	4	From list of subjects from allied fields 1.Internetworking 2. MEMS 3. Network Security and Cryptography 4. Adhoc Wireless and Sensor Netwroks 5. Mobile Computing Technologies 6. Data Warehousing and Data Mining 7. Neural Networks and Fuzzy Logic 8. Mathematical Foundations of Computer Networks 9. Sensors for Ranging and Imaging
	Total Minimum credits		15	

Paper Title: Research Presentation

L T P
0 0 3

Research Scholar will have to present a seminar based upon his/her research area. Performance of the scholar and participation in seminar will be taken into consideration.

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Pre Ph.D. Course in Electronics and Communication Engineering
Research Methodology

L	T	P
4	0	0

1. Introduction Research Methodology: Definition of Research, Need of Research, Concept and steps of Research Methodology , Uses of Research Methodology, Research Techniques. Reviewing Literature: Need, Sources-Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.
2. Identifying and defining research problem: Locating. Analyzing stating and evaluating problem, Generating different types of hypotheses and evaluating them.
3. List of important journals in Electronics and Communication Engineering, impact factor, research articles, research papers, reviews, scientific popular articles, process of reviewing, literature review, Identification and formulation of problem, Research design, Sampling techniques, Data Collection, Statistical and sensitive analysis of data, Interpretation of result.
4. Research reports and Thesis writing: Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, word processing tools such as Latex Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.
5. Statistical Methods of Analysis: Descriptive statistics: Meaning, graphical representations, mean, range and standard deviation, characteristics and uses of normal curve. Inferential statistics: t-test. Chi-square tests. Correlation (rank difference and product moment), ANOVA (one way).
6. Research ethics, IPR and publishing Ethics: ethical issues. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Books:

1. C.R. Kothari, "Research Methodology – Methods and Techniques", Wiley Eastern Ltd 2009.
2. Richard I. Levin, David S. Rubin, Statistics for Management (7th Edition), Pearson Education India.
3. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan," Management Research Methodology: Integration of Methods and Techniques, Pearson, 2006 4. S.P Gupta,"Statistical Methods", Sultan Chand & Sons, 2006.
4. Probability and Statistics in Engineering, Hines, Montgomery, Goldsman and Borror, 4th ed, 2003, John Wiley & Sons.
5. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.

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Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Data Warehousing and Data Mining

L	T	P
4	0	0

1. Introduction: Introduction to RDBMS, Data Warehouse, Transactional Databases, Data Mining Functionalities, Interestingness of pattern, classification of data mining system, major issues
2. Data Warehouse and OLAP: Difference from traditional databases, Multidimensional data model, Schema for Multi dimensional model, measures, concept hierarchies, OLAP operations, starnet query model, Data Warehouse architecture, ROLAP, MOLAP, HOLAP, Data Warehouse Implementation, Data Cube, Metadata Repositories, OLAM
3. Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept hierarchy generation
4. Data Mining Architecture: Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Concept Description, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons,
5. Association Rules: Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlational analysis, Constraint based association mining
6. Classification and Clustering: Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbor classification, Cluster analysis, Types of data in clustering, categorization of clustering methods

Books:

1. Data Mining: Concepts and Techniques By J.Han and M. Kamber By Morgan Kaufman publishers, Harcourt India pvt. Ltd. Latest Edition
2. Data Mining Introductory and Advance Topics By Dunham, Pearson Education, Latest Edition

Cognitive radicon

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5

Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Neural Networks and Fuzzy Logic

L	T	P
4	0	0

1. Fundamentals of Neural Networks: Introduction, Biological Neurons and Memory, Structure & Function of a single Neuron, Artificial Neural Networks (ANN). Typical Application of ANN - Classification, Clustering, Pattern Recognition, Function Approximation. Basic approach of the working of ANN – Training, Learning and Generalization.
2. Supervised Learning: Single-layer Networks, Linear Separability, handling linearly non-separable sets. Training algorithm. Error correction & gradient decent rules. Multi-layer network- Architecture, Back Propagation Algorithm (BPA) – Various parameters and their selection, Applications, Feedforward Network, Radial- Basis Function (RBF) network & its learning strategies.
3. Unsupervised Learning: Winner-takes all Networks, Hamming Networks. Adaptive Resonance Theory, Kohonen's, Self-organizing Maps.
Neurodynamical models: Stability of Equilibrium states, Hopfield Network, Brain-state-in-aBox network, Bidirectional associative memories.
4. Fuzzy Logic: Basic concepts of Fuzzy Logic, Fuzzy vs. Crisp set Linguistic variables, membership functions, operations of fuzzy sets, Crisp relations, Fuzzy relations, Approximate reasoning, fuzzy IF-THEN rules, variable inference, techniques, defuzzification techniques, Fuzzy rule based systems. Applications of fuzzy logic.

Books:

1. Satish Kumar,"Neural Network : A classroom approach".
2. Jacek M.Zurada," Artificial Neural Networks".
3. Simon Haykin," Artifical Neural Network".
4. Rajasekaran & Pai,"Neural networks, Fuzzy logic and genetic algorithms".
5. Hagan, Demuth & Beale,"Neural Network Design.".
6. T. J. Ross," Fuzzy logic with engineering applications"

N T Chatha

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Pre Ph.D. Course in Electronics and Communication Engineering
RF & Microwave System Design

L	T	P
4	0	0

1. Introduction: Importance of RF and Microwave Concepts and Applications- and UnitsFrequency Spectrum, RF and Microwave Circuit Design, Dimensions - RF Behavior of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors, General Introduction, Types of Transmission Lines-Equivalent Circuit representation.
2. The Smith Chart: Introduction, Derivation of Smith Chart, Description of two types of smith chart, Z-Y Smith chart, Distributed Circuit Applications, Lumped Element Circuit Applications. SINGLE AND MULTIPORT NETWORKS: Basic Definitions, Interconnecting Networks.
3. Scattering Parameters: Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, Conversion between S and Z-parameters, Signal Flow Chart Modeling.
4. Stability and Gain Considerations – RF Design RF Source, Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, and Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles.
5. RF Filters, Amplifiers And Oscillators Design Generalization-Basic Resonator and Filter Configurations: Low Pass, High Pass, Band Pass and Band Stop type Filters-Filter Implementation using Unit Element and Kuroda's Identities Transformations. Introduction, Types and Characteristics of Amplifiers, Small Signal Amplifiers, Design of different types of amplifiers (NBA, HGA, MGA, LNA, MNA, BBA), Design of Large Signal Amplifiers Oscillator vs Amplifier Design, Design procedure of Transistor Oscillators.

BOOKS

1. Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition.
2. Reinhold Ludwig and Powel Bretchko," RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition.\
3. Devendra K. Misra, "Radio Frequency and Microwave Communication Circuits – Analysis and Design "John Wiley & Sons, Inc.
4. Jon B. Hagen, "Radio Frequency Electronics ", Cambridge university press, Cambridge, 1996.
5. James Hardy, "High Frequency Circuit Design ", Resto Publishing Co., New York, 1979.

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Pre Ph.D. Course in Electronics and Communication Engineering
Image and Video Processing

L	T	P
4	0	0

1. Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.
2. Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.
3. Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.
4. Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.
5. 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

BOOKS

1. Gonzalez and Woods , "Digital Image Processing", 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication", 1st edition, PHI.
3. M. Tekalp, "Digital video Processing", Prentice Hall International

Segmentation
Region
Fusion

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Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Mathematical Foundations of Computer Networks

L	T	P
4	0	0

1. Basic algorithms on directed graphs, weighted shortest paths.

2. Networks and routing algebras - fixed-point equations, sequential algorithm to solve the fixed-point equations, generalized distance-vector and link-state routing protocols.

3. Applications to quality-of service intra-domain routing and to policy-based inter-domain routing in the Internet.

4. Network flows - flows and residual networks, Max-flow Min-cut theorem, Ford Fulkerson method and Edmonds-Karp algorithm.

5. Network calculus- Min-plus calculus: integrals and convolutions, Arrival curves and token buckets; service curves and schedulers, Applications to integrated and differentiated services in the Internet.

Books:

1. Thomas Cormen, Charles Leiserson, Ronald Rivest, and Clifford Stein. Introduction to algorithms, 2th edition. The MIT Press 2001 [Chapter VI]
2. Jorgen Bang-Jensen and Gregory Gutin. Digraphs: theory, algorithms and applications. Springer, 2002 [Section 7.3 and 9.5]
3. J. L. Sobrinho, An algebraic theory of dynamic network routing, IEEE/ACM Transactions on Networking, 13(5), October 2005.
4. Jean-Yves Le Boudec and Patrick Thiran. Network calculus. Springer, 2006. [Chapter 1, 2, and 3]

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Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Sensors For Ranging and Imaging

L	T	P
4	0	0

1. Introduction to sensing Introduction, brief history of sensing, Passive infrared sensing, sensor systems, frequency band allocations for the electromagnetic spectrum, acoustic spectrum

2. Active Ranging and Imaging Sensors Overview, Pulsed Time-of-Flight Operation, Pulsed Range Measurement, Other Methods to Measure Range, the Radar Range Equation, The Acoustic Range Equation, Range Measurement Radar for a Cruise Imaging Techniques, Range –Gate limited 2D Image Construction, Beam width limited 3D Image Construction, The Lidar Range Equation, Lidar System Performance, Digital Terrain Models, Airborne Lidar Hydrography, 3D Imaging, Acoustic Imaging, Lidar Locust Tracker

3. Target and Clutter Characteristics Introduction, Target cross –section, Radar cross-sections(RCS),RCS of Simple shapes, Radar cross section of complex Targets , Effect of Target, RCS of living creatures, fluctuations in Radar Cross-section, Radar Stealth, Target cross section in Infrared, Acoustic Target Crosssection, clutter, Orepass Radar Development, Detecting Targets in clutter, Target Detection with Air Surveillance Radar

4. Tracking Moving Targets Tracking While Scan, The Coherent Pulsed Tracking Radar, Range-Gated Pulsed Doppler Tracking, Coordinate Frames, Antenna Mounts and servo systems, On-Axis Tracking, Tracking in Cartesian Space, fire Control Radar

5. Radio Frequency Identification Tags and Transponders Principles of Operation, History, Secondary Surveillance Radar, RFID Systems, other Applications, Technical Challenges, Harmonic Radar

Book

1. Introduction to Sensors for Ranging and Imaging, Dr.Graham Brooker, Yes Dee Publishing Pvt. Ltd ,2012.
2. Introduction to Remote sensing , James B Campbell, Third Edition, Taylor and Francis
3. Principles of Remote sensing, ITC Educational Text Book Series 2
4. Introduction to sensor systems,Shahen A. Hovanessian
5. Space Mission Analysis and Design James R. Wertz,Wiley J. Larson, 1999

Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Adhoc Wireless and Sensor Networks

L	T	P
4	0	0

1. Wireless LANS and PANS: Introduction, Fundamentals of WLANS, IEEE 802.11 Standard, HIPERLAN Standard, Bluetooth, Home RF. Wireless Internet: Wireless Internet, Mobile IP, TCP in Wireless Domain, WAP, Optimizing Web Over Wireless.
2. AD HOC Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks, AD Hoc Wireless Internet. MAC Protocols for Ad Hoc Wireless Networks: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.
3. ROUTING PROTOCOLS: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols. Transport layer and Security Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks, Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks.
4. QUALITY OF SERVICE: Introduction, Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions, QoS Frameworks for Ad Hoc Wireless Networks. ENERGY MANAGEMENT: Introduction, Need for Energy Management in Ad Hoc Wireless Networks, Classification of Ad Hoc Wireless Networks, Battery Management Schemes, Transmission Power Management Schemes, System Power Management Schemes.
5. WIRELESS SENSOR NETWORKS: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

BOOKS: 1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control Jagannathan Sarangapani, CRC Press.
3. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh ,1 ed. Pearson Education.
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Mobile Computing Technologies

L	T	P
4	0	0

1. Introduction to Mobile Computing Architecture Mobile Computing – Middleware and Gateways – Application and Services – Developing Mobile Computing Applications – Security in Mobile Computing – Architecture for Mobile Computing – Three Tier Architecture – Design considerations for Mobile Computing – Mobile Computing through Internet – Making existing Applications Mobile Enabled. Cellular Technologies: GSM, GPS, GPRS, CDMA and 3G Bluetooth – Radio Frequency Identification – Wireless Broadband – Mobile IP – Internet Protocol Version 6 (IPv6) – Java Card – GSM Architecture – GSM Entities – Call Routing in GSM – PLMN Interfaces – GSM addresses and Identifiers – Network aspects in GSM – Authentication and Security – Mobile computing over SMS – GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations – Data Services in GPRS – Applications for GPRS – Limitations of GPRS.

2. Wireless Application Protocol (WAP) and Wireless LAN WAP – MMS – Wireless LAN Advantages – IEEE 802.11 Standards – Wireless LAN Architecture – Mobility in wireless LAN Intelligent Networks and Interworking Introduction – Fundamentals of Call processing – Intelligence in the Networks – SS#7 Signaling – IN Conceptual Model (INCM) – softswitch – Programmable Networks – Technologies and Interfaces for IN

3. Client Programming, Palm OS, Symbian OS, Win CE Architecture Introduction – Moving beyond the Desktop – A Peek under the Hood: Hardware Overview – Mobile phones – PDA – Design Constraints in Applications for Handheld Devices – Palm OS architecture – Application Development – Multimedia – Symbian OS Architecture – Applications for Symbian, Different flavors of Windows CE -Windows CE Architecture J2ME JAVA in the Handset – The Three-prong approach to JAVA Everywhere – JAVA 2 Micro Edition (J2ME) technology – Programming for CLDC – GUI in MIDP – UI Design Issues – Multimedia – Record Management System

4. Voice over Internet Protocol and Convergence Voice over IP- H.323 Framework for Voice over IP – Session Initiation Protocol – Comparision between H.323 and SIP – Real Time protocols – Convergence Technologies – Call Routing – Voice over IP Applications – IP multimedia subsystem (IMS) – Mobile VoIP Security Issues in Mobile Computing Introduction – Information Security – Security Techniques and Algorithms – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security frameworks for Mobile Environment

BOOKS: 1. Mobile Computing – Technology, Applications and Service Creation – Asoke K Talukder, Roopa R Yavagal, 2009, TATA McGraw Hill

2. Mobile Communications – Jochen Schiller – 2nd Edition – Pearson Education

3. The CDMA 2000 System for Mobile Communications – Vieri Vaughi, Alexander Damn Jaonvic – Pearson

4. ADALESTEIN : Fundamentals of Mobile & Parvasive Computing, 2008, TMH.

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Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Micro Electromechanical Systems

L	T	P
4	0	0

1. Introduction, basic structures of MEM devices – (Canti-Levers, Fixed Beams diaphragms). Broad Response of Micro electromechanical systems (MEMS) to Mechanical (Force, pressure etc.) Thermal, Electrical, optical and magnetic stimuli, compatibility of MEMS from the point of power dissipation, leakage etc.
2. Review of mechanical concepts like stress, strain, bending moment, deflection curve. Differential equations describing the deflection under concentrated force, distributed force, distributed force, deflection curves for canti-levers- fixed beam. Electrostatic excitation – columbic force between the fixed and moving electrodes. Deflection with voltage in C.L, Deflection Vs Voltage curve, critical fringe field – field calculations using Laplace equation. Discussion on the approximate solutions – transient response of the MEMS.
3. Two terminal MEMS - capacitance Vs voltage Curve – variable capacitor. Applications of variable capacitors. Two terminal MEM structures. Three terminal MEM structures – controlled variable capacitors – MEM as a switch and possible applications.
4. MEM circuits & structures for simple GATES- AND, OR, NAND, NOR, Exclusive OR<simple MEM configurations for flip-flops triggering applications to counters, converters. Applications for analog circuits like frequency converters, wave shaping. RF Switches for modulation. MEM Transducers for pressure, force temperature. Optical MEMS.
5. MEM Technologies: Silicon based MEMS- process flow – brief account of various processes and layers like fixed layer, moving layers spacers etc., and etching technologies. Metal Based MEMS: Thin and thick film technologies for MEMS. Process flow and description of the processes. Status of MEMS in the current electronics scenario.

BOOKS:

1. MEMS Theory, Design and Technology - GABRIEL. M.Review, R.F.,2003, John wiley & Sons.
2. Strength of Materials –Thimo Shenko, 2000, CBS publishers & Distributors.
3. MEMS and NEMS, Systems Devices; and Structures - Servey E.Lyshevski, 2002, CRC Press.
4. Sensor Technology and Devices - Ristic L. (Ed) , 1994, Artech House, London

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Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Network Security and Cryptography

L	T	P
4	0	0

1. Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.
2. Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations. Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers. Conventional Encryption:Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation. Public Key Cryptography:Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.
3. Number theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms. Message authentication and Hash functions:Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.
4. Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. Authentication Applications: Kerberos, X.509 directory Authentication service.Electronic Mail Security: Pretty Good Privacy, S/MIME.
5. IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction. Intruders, Viruses and Worms : Intruders, Viruses and Related threats. Fire Walls : Fire wall Design Principles, Trusted systems.

BOOK:

1. Cryptography and Network Security: Principles and Practice - William Stallings, 2000, PE.
2. Principles of Network and Systems Administration, Mark Burgess,John Wielly.

Pre Ph.D. Course in Electronics and Communication Engineering
Optical Networks

L	T	P
4	0	0

1. Client Layers of Optical Networks SONET / SDH – Multiplexing, Frame Structure, Physical Layer, Infrastructure, ATM – Functions, Adaptation layers, QoS, Flow Control Signaling and Routing, IP – Routing, QoS, MPLS, Storage Area Networks – ESCON, Fiber Channel, HIPPI, Gigabit Ethernet.
2. WDM network Elements and Design Optical Line Terminals and Amplifiers, Add/Drop Multiplexers, Optical Cross Connects, Cost trade-offs in Network Design, LTD and RWA Problems, Dimensioning – Wavelength Routing Networks, Statistical and Maximum Load Dimensioning Models.
3. Network Control and Management Network Management Functions, Optical Layer Services and Interfacing, Layers within Optical Layer, Multivendor Interoperability, Performance and Fault Management, Configuration Management, Optical Safety.
4. Network Survivability Basic Concepts of Survivability, Protection in SONET/SDH Links and Rings, Protection in IP Networks, Optical Layer Protection – Service Classes, Protection Schemes, Interworking between Layers. Access Networks and Photonic Packet Switching Network Architecture, Enhanced HFC, FTTC, Photonic Packet Switching – OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Test Beds.

BOOKS:

1. Optical Networks: A Practical Perspective - Rajiv Ramaswami and Kumar N. Sivarajan, 2 ed., 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
2. WDM Optical Networks: Concepts, Design and Algorithms – C. Siva Rama Murthy and Mohan Guruswamy 2 ed., 2003, PEI.
3. Optical Networks: Third Generation Transport Systems – Uyless Black, 2 ed., 2009, PEI.
4. Optical Fiber Communications: Principles and Practice – John.M.Senior, 2 ed., 2000, PE.
5. Fiber Optics Communication – Harold Kolimbris, 2 ed., 2004, PEI.
6. Networks – Timothy S. Ramteke, 2 ed., 2004, PEI.
7. Optical Fiber Communications – Govind Agarwal, 2 ed., 2004, TMH.

Inter Disciplinary course

Pre Ph.D. Course in Electronics and Communication Engineering
Internetworking

L	T	P
4	0	0

1. Internetworking concepts: Principles of Internetworking, Connectionless Internetworking, Application level Interconnections, Network level Interconnection, Properties of the Internet, Internet Architecture, Wired LANS, Wireless LANs, Point-to-Point WANs, Switched WANs, Connecting Devices, TCP/IP Protocol Suite. IP Address: Classful Addressing: Introduction, Classful Addressing, Other Issues, Sub-netting and Super-netting IP Address: Classless Addressing: - Variable length Blocks, Sub-netting, Address Allocation. Delivery, Forwarding, and Routing of IP Packets: Delivery, Forwarding, Routing, Structure of Router. ARP and RARP:ARP, ARP Package, RARP.
2. Internet Protocol (IP): Datagram, Fragmentation, Options, Checksum, IP V.6. Transmission Control Protocol (TCP): TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Flow Control, Error Control, Congestion Control, TCP Times. Stream Control Transmission Protocol (SCTP): SCTP Services, SCTP Features, Packet Format, Flow Control, Error Control, Congestion Control. Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP. Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/ Time Out Freezing, Selective Retransmission, Transaction Oriented TCP.
3. Unicast Routing Protocols (RIP, OSPF, and BGP: Intra and Inter-domain Routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP. Multicasting and Multicast Routing Protocols: Unicast - Multicast- Broadcast, Multicast Applications, Multicast Routing, Multicast Link State Routing: MOSPF, Multicast Distance Vector: DVMRP.
4. Domain Name System (DNS): Name Space, Domain Name Space, Distribution of Name Space, and DNS in the internet. Remote Login TELNET:- Concept, Network Virtual Terminal (NVT). File Transfer FTP and TFTP: File Transfer Protocol (FTP). Electronic Mail: SMTP and POP. Network Management-SNMP: Concept, Management Components. World Wide Web- HTTP Architecture. Multimedia: Digitizing Audio and Video, Network security, security in the internet firewalls. Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live Audio/Video, Real-Time Interactive Audio/Video, RTP, RTCP, Voice Over IP. Network Security, Security in the Internet, Firewalls.

BOOKS:

1. TCP/IP Protocol Suite- Behrouz A. Forouzan, Third Edition, TMH
2. Internetworking with TCP/IP Comer 3 rd edition PHI
3. High performance TCP/IP Networking- Mahbub Hassan, Raj Jain, PHI, 2005
4. Data Communications & Networking – B.A. Forouzan – 2ndEdition – TMH
5. High Speed Networks and Internets- William Stallings, Pearson Education, 2002.

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Pre Ph.D. Course in Electronics and Communication Engineering
Coding Theory and Techniques

L	T	P
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1. Coding for Reliable Digital Transmission and storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system
2. Cyclic codes: Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.
3. Convolutional codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.
4. Burst –Error-Correcting codes: Decoding of Signle-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convoulutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes , Phased-Burst –Error-Correcting Cyclic and Convolutional codes.
5. BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

TEXT BOOKS:

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.
3. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, 2006, Wiley India.
4. Information Theory, Coding and Cryptography – Ranjan Bose, 2ndEdition, 2009, TMH

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Pre Ph.D. Course in Electronics and Communication Engineering
Optical Communications Technology

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1. Signal propagation in Optical Fibers Geometrical Optics approach and Wave Theory approach, Loss and Bandwidth, Chromatic Dispersion, Non Linear effects- Stimulated Brillouin and Stimulated Raman Scattering, Propagation in a Non-Linear Medium, Self Phase Modulation and Cross Phase Modulation, Four Wave Mixing, Principle of Solitons.
2. Fiber Optic Components for Communication & Networking Couplers, Isolators and Circulators, Multiplexers, Bragg Gratings, Fabry-Perot Filters, Mach Zender Interferometers, Arrayed Waveguide Grating, Tunable Filters, High Channel Count Multiplexer Architectures, Optical Amplifiers, Direct and External Modulation Transmitters, Pump Sources for Amplifiers, Optical Switches and Wavelength Converters.
3. Modulation and Demodulation Signal formats for Modulation, Subcarrier Modulation and Multiplexing, Optical Modulations – Duobinary, Single Side Band and Multilevel Schemes, Ideal and Practical receivers for Demodulation, Bit Error Rates, Timing Recovery and Equalization, Reed-Solomon Codes for Error Detection and Correction.
4. Transmission System Engineering System Model, Power Penalty in Transmitter and Receiver, Optical Amplifiers, Crosstalk and Reduction of Crosstalk, Cascaded Filters, Dispersion Limitations and Compensation Techniques.
5. Fiber Non-linearities and System Design Considerations Limitation in High Speed and WDM Systems due to Non-linearities in Fibers, Wavelength Stabilization against Temperature Variations, Overall System Design considerations – Fiber Dispersion, Modulation, Non-Linear Effects, Wavelengths, All Optical Networks.

BOOKS:

1. Optical Networks: A Practical Perspective - Rajiv Ramaswami and Kumar N. Sivarajan, 2 ed., 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
3. Optical Fiber Communications – Gerd Keiser, 3 ed., 2000, McGraw Hill. REFERENCES:
4. Optical Fiber Communications: Principles and Practice – John.M.Senior, 2 ed., 2000, PE.
5. Fiber Optics Communication – Harold Kolimbris, 2 ed., 2004, PEI
6. Optical Networks: Third Generation Transport Systems – Uyless Black, 2 ed., 2009, PEI
7. Optical Fiber Communications – Govind Agarwal, 2 ed., 2004, TMH.

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Pre Ph.D. Course in Electronics and Communication Engineering
Low Power VLSI Circuits

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1. Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.
2. Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.
3. Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.
4. Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.
5. Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.
6. Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, precomputation logic.
7. Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.
8. Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.

BOOKS

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic
3. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000
4. Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education

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Pre Ph.D. Course in Electronics and Communication Engineering
Advanced Data Communication

L	T	P
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1. Digital Modulation: Introduction, Information Capacity Bits, Bit Rate, Baud, and M-ARY Coding, ASK, FSK, PSK, QAM, BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.

2.Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Components, Networks, Distributed Processing, Network Criteria- Applications, Protocols and Standards, Standards Organizations- Regulatory Agencies, Line Configuration- Point-to-point Multipoint, Topology- Mesh- Star- Tree- Bus- Ring- Hybrid Topologies, Transmission Modes Simplex- Half duplex- Full Duplex, Categories of Networks- LAN, MAN, WAN and Internetworking, Digital Data Transmission- Parallel and Serial, DTE- DCE Interface- Data Terminal Equipment, Data Circuit- Terminating Equipment, Standards EIA 232 Interface, Other Interface Standards, Modems- Transmission Rates.

3. Error Detection and Correction: Types of Errors- Single- Bit Error, CRC (Cyclic Redundancy Check)- Performance, Checksum, Error Correction- Single-Bit Error Correction, Hamming Code. Data link Control: Stop and Wait, Sliding Window Protocols. Data Link Protocols: Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocol- Binary Synchronous Communication (BSC) - BSC Frames- Data Transparency, Bit Oriented Protocols – HDLC, Link Access Protocols.

4. Switching: Circuit Switching- Space Division Switches- Time Division Switches- TDM Bus Space and Time Division Switching Combinations- Public Switched Telephone Network, Packet Switching, Circuit Switched Connection Versus Virtual Circuit Connection, Message Switching.

5. Multiplexing: Time Division Multiplexing (TDM), Synchronous Time Division Multiplexing, Digital Hierarchy, Statistical Time Division Multiplexing. Multiple Access: Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Detection (CSMA)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization- Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), - Code - Division Multiple Access (CDMA).

BOOKS:

1. Data Communication and Computer Networking - B. A.Forouzan, 3rded., 2008, TMH.
2. Advanced Electronic Communication Systems - W. Tomasi, 5 ed., 2008, PEI.
3. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
4. Data and Computer Communications - William Stallings, 8thed., 2007, PHI.
5. Data Communication and Tele Processing Systems - T. Housely, 2ndEdition, 2008, BSP.
6. Data Communications and Computer Networks- Brijendra Singh, 2nded., 2005, PHI.
7. Telecommunication System Engineering – Roger L. Freeman, 4/ed., Wiley-Interscience, John Wiley & Sons, 2004.

Pre Ph.D. Course in Electronics and Communication Engineering
Bio Medical Signal Processing

L	T	P
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1. Introduction To Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc., Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments.
2. Concurrent, Coupled and Correlated Processes - Illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Musclecontraction interference. Event detection - case studies with ECG & EEG - Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.
3. Cardio Vascular Applications : Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multi-scale analysis for ECG parameters estimation - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis
4. Data Compression: Lossless & Lossy- Heart Rate Variability – Time Domain measures - Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.
5. Neurological Applications: The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models – Non-linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.

BOOKS

1. D.C.Reddy ,"Biomedical Signal Processing: Principles and techniques" ,Tata McGraw Hill, New Delhi, 2005
2. Willis J Tompkins , Biomedical Signal Processing -, ED, Prentice – Hall, 1993
3. R. Rangayan, "Biomedical Signal Analysis", Wiley 2002. 2. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001

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Pre Ph.D. Course in Electronics and Communication Engineering
MOS Circuit Design

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1. Introduction: Classification of CMOS digital circuits and Circuit design, Overview of VLSI design methodologies, VLSI design flow, Design hierarchy and concepts, VLSI design styles, Design quality, Packing technology, CAD technology, Fabrication process flow, CMOS nwell process, layout design rules.
2. MOS Transistor and Circuit Modeling: MOS structure, MOS system under external bias, structure and operation of MOS transistor, MOSFET current-voltage characteristics, MOSFET scaling and small-geometry effects, MOSFET capacitances, Modeling of MOS transistor using SPICE.
3. MOS Inverter static characteristics and Interconnect Effects: Introduction, ResistiveLoad Inverter, Inverter with n-type MOSFET load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.
4. Combinational and Sequential MOS logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic Circuits, Complex logic circuits, CMOS transmission gates (Pass gates), Behavior of bi-stable elements, SR latch circuit, clocked latch and flipflop circuits, CMOS D-latch and Edge-triggered flip-flop.
5. Dynamic logic Circuits: Basic principles of pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques, Highperformance dynamic CMOS circuits.

BOOKS

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits" TMH 2003
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, "CMOS VLSI Design" - Pearson Education, 1999.
3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits" Pearson Education, 2003
4. Uyemura, "Introduction to VLSI Circuits and Systems" Wiley-India, 2006.
5. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall, 1998.
6. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.

SIMULATION BOOK 1. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

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Pre Ph.D. Course in Electronics and Communication Engineering
Radiating Systems

L	T	P
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1. Basics Concepts Of Radiation: Radiation from surface current and current line current distribution, Basic antenna parameters, Radiation mechanism-Current distribution of Antennas, Impedance concept-Balanced to Unbalanced transformer.
2. Radiation from Apertures Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Aperture fields of Horn antenna-Babinets principle, Geometrical theory of diffraction, Reflector antennas, and Design considerations - Slot antennas.
3. Synthesis of Array Antennas Types of linear arrays, current distribution in linear arrays, Phased arrays, Optimization of Array patterns, Continuous aperture sources, Antenna synthesis techniques.
4. Micro Strip Antennas Radiation mechanisms, Feeding structure, Rectangular patch, Circular patch, Ring antenna. Input impedance of patch antenna, Micro-strip dipole, Microstrip arrays.
5. EMI/EMC/Antenna Measurements: Log periodic, Bi-conical, Log spiral ridge Guide, Multi turn loop, Traveling Wave antenna, Antenna measurement and instrumentation, Amplitude and Phase measurement, Gain, Directivity, Impedance and polarization measurement, Antenna range, Design and Evaluation.

BOOKS

1. Kraus.J.D.,"Antennas"II Edition, John wiley and Sons.
2. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982
3. RF System Design, Peter Kinget Bell Laboratories, Lucent Technologies Murray Hill,
4. Practical RF system design, Wiley-IEEE, 2003 - Technology & Engineering

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Pre Ph.D. Course in Electronics and Communication Engineering
Microwave and Millimeter Wave Circuits

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1. Analysis of Microwave Circuits: Introduction, Microwave Components – E-plane Tee, Hplane Tee, Magic Tee, Directional Coupler, Isolator, Circulator & their Scattering.
2. Transformers & Resonators: Parameters, Impedance Transformers – Quarter wave Transformers, Microwave Resonators – Rectangular and Cylindrical Resonators.
3. Filters And Periodic Structures: Design of Narrow Band Low Pass, Band Pass and High Pass Filters, Maximally flat and Chebyshev Designs, Introduction to Periodic Structures, Floquet's Theorem, Circuit Theory Analysis of Infinite and Terminated Structures.
4. Obstacles In Wave Guides: Introduction, Posts in Waveguides, Diaphragms in Waveguides, Waveguide Junctions, Waveguide Feeds, Excitation of Apertures.
5. Millimeter Wave Circuits: Wave Propagation in micro-strip lines, Discontinues in Microstrips, Parallel Coupled lines, Power Dividers and Directional Couplers, Microwave and Millimeter Wave Integrated Circuits.

BOOKS

1. Roger F. Harrington, "Time-Harmonic Electromagnetic Fields", Mc graw-hill
2. Robert E Collin, "Foundation For Microwave Engineering", Mc Graw-Hill.
3. Cam Nguyun, "Analysis Methods for RF, Microwave, and Millimeter-Wave Planar Transmission Line Structures".

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Pre Ph.D. Course in Electronics and Communication Engineering
Advanced Digital Signal Processing

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1. Transformations: Review of Z-Transform, Solution of Linear Difference Equations, Fourier series and Fourier Transform, Discrete Fourier Transform, Radix-2 FFT. Introduction to Radix-4 and Split Radix FFT, Discrete Cosine Transform, DCT as Orthogonal Transform, Walsh Transform, Hadamard Transform, Wavelet Transform.
2. Digital Filters: FIR Filter Design: Filter Specifications, Coefficient Calculation Methods-Window method, Optimal method, Frequency Sampling method. Realization Structures, Finite Word Length Effects.IIR Filter Design: Specifications, Coefficient Calculation methods- Pole-Zero Placement method, Impulse Invariant method, Matched Z-Transform method, Bilinear Z Transformation method, Use of BZT and Classical Analog Filters to design IIR Filters. Realization Structures, Finite Word Length Effects.
3. Multirate Digital Signal Processing: Sampling Rate Alteration Devices, Multirate Structures for sampling rate conversion, Multistage design of Decimator and Interpolator, The Polyphase Decomposition, Arbitrary Rate Sampling Rate Converter, Filter Banks, QMF banks, Multilevel Filter Banks, Sub-band Coding, Discrete Wavelet Transform.
4. Linear Prediction and Optimum Linear Filters: Forward and Backward Linear Prediction, Properties of Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.
5. Adaptive Digital Filters: Concepts of Adaptive Filtering, LMS Adaptive Algorithm, Recursive Least Squares Algorithm, Applications.
6. DSP Chips: Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx- Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.

Books:

1. "Digital Signal Processing: A Practical Approach", by Ifeacher & Jervis, -Pearson Education.
2. "Digital Signal Processing: Principles, Algorithms and Applications", by Proakis & Manolakis, 4e, -Pearson Education.
3. "Digital Signal Processing", by S.K.Mitra, -Tata-Mcgraw Hill.
4. "Discrete Time Signal Processing", Oppenheim & Schafer. PHI.
5. "Fundamentals of Digital Signal Processing using MATLAB", by Robert J. Schilling & Sndra L. Harris. -CENGAGE Learning.
6. "Digital Signal Processing", by Salivahanan, Vallavaraj & Gnanapriya, - Tata-Mcgraw Hill.

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Pre Ph.D. Course in Electronics and Communication Engineering
Real Time Concepts for Embedded Systems

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RTOS

1. Introduction: Examples of Embedded Systems, Definition of Embedded Systems, Architecture of Embedded Systems, Real- Time Embedded Systems , Design Issues and Current Trends for Embedded Systems Hard versus soft Real- Time Systems: Jobs and Processes, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real Time Systems, Soft Real Time Systems.
2. Reference Model of Real – Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency, Functional Parameters- pre-emptivity of jobs, criticality of jobs, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy- Scheduler and Schedules, Feasibility, Optimality and Performance Measures.
3. Classification of Real Time Scheduling Approaches: Clock- Driven Approach, Weighted Round- Robin Approach, Priority- Driven Approach, Dynamic versus Static Systems, Effective Release Times and Deadlines, optimality of the EDF and LST algorithms, Non optimality of the EDF and LST algorithms, Challenges in validating timing constraints in priority –driven systems Off-line versus On-line Scheduling.
4. Clock-Driven Scheduling : Notations and Assumptions, Static, Timer -Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of Aperiodic Jobs, Scheduling Sporadic Jobs-Acceptance test ,EDF Scheduling of accepted jobs and implementation, Pros and Cons of Clock Driven Scheduling.
5. Priority-Driven Scheduling of Periodic Tasks: Static Assumption, Fixed Priority v/s Dynamic Priority Algorithms, schedulability test for the EDF algorithm, a schedulability test for fixed priority tasks with short response times-time demand analysis, schedulability test for fixed priority tasks with arbitrary response times: busy intervals, general schedulability test, sufficient schedulability conditions for RM & DM algorithms: schedulable utilization of the RM algorithm for tasks with Di=pi, schedulable utilization of fixed priority tasks with arbitrary relative deadlines.
6. Real-Time Operating Systems: Overview- Threads and Tasks, The Kernel, Time Services and Scheduling Mechanisms- Time Services, Scheduling Mechanisms, Other Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt, Memory Management, I/O and Networking.

BOOKS:

1. Real Time Systems – By Jane W.S.Liu -Low Price Edition , Pearson Education Asia
2. Real-Time Concepts for Embedded Systems - Qing Li with Caroline Yao published by CMP Books

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Pre Ph.D. Course in Electronics and Communication Engineering
Advanced Wireless Communication

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1. REVIEW OF FUNDAMENTALS OF WIRELESS COMMUNICATION: MULTIPATH FADING, MULTIPATH CHANNEL MODELS, CAPACITY OF WIRELESS CHANNELS.
2. PERFORMANCES OF DIGITAL MODULATION OVER WIRELESS CHANNELS: AGWN CHANNELS SIGNAL TO NOISE POWER RATIO AND BIT/SYMBOL ENERGY, ERROR PROBABILITY FOR BPSK, QPSK, MPSK,MPAM, MQAM- THEIR COMPARISION.
3. MULTICARRIER MODULATION: DATA TRANSMISSION USING MULTIPLE CARRIERS, MULTICARRIER MODULATUION WITH OVERLAPPING SUBCHANNELS, MITIGATION OF SUBCARRIER FADING, DISCRETE IMPLEMENTATION OF MULTICARRIER MODULATION, CHALLENGES IN MULTICARRIER SYSTEMS.
4. INTRODUCTION TO WIRELESS OFDM: OFDM PRINCIPLES, SYSTEM MODEL, GENERATION OF SUB CARRIER USING IFFT, GUARD TIME, CYCLIC EXTENSION, WINDOWING, OFDM PARAMETERS, OFDM SIGNAL PROCESSING, COHERENT AND DIFFERENTIAL DETECTION
5. OFDMA: FREQUENCY HOPPING IN OFDMA, DIFFERENCE BETWEEN OFDMA AND MC-CDMA, OFDMA SYSTEM DESCRIPTION-CHANNEL CODING, FREQUENCY SYNCHRONIZATION, INITIAL MODULATION TIMING ANF FREQUENCY OFFSET SYNCHRONIZATION ACCURACY, RANDOM FREQUENCY HOPPING OPERATION, APPLICATIONS OF OFDMA.

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Books:

1. A.Goldsmith, "Wireless Communications, Cambridge Univ. Press, 2005.
2. R.Vannee and R.Prasad, "OFDM for Wireless Multimedia Communication, Artech House, 2000.
3. M.Engels, Wireless OFDM systems, Klumer Academic Publishers, 2002.
4. Raj Pandya,"Mobile and personal Communication Systems and services", PHI
5. Theodore S. Rappaport, 'Wireless Communications Principles & Practice', PHI,2007
6. J.W. Mark & W. Jhuang, 'Wireless Communications & Networking', PHI,2006

Pre Ph.D. Course in Electronics and Communication Engineering
Advanced Communication Systems

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1. Introduction Introduction to communications systems, analog and digital communication systems, Applications of communication systems.
2. Digital Communication Introduction, Digital Modulation techniques, BPSK, QPSK, PCM, DPCM, Delta Modulation, Digital Transmission and Transmission Impairments.
3. Optical Networks WDM, TDM, Telecommunication Infrastructure, Switching, 3G systems, SONET, SDH, Architecture of Optical Transport Network, Link Management Protocols, Solutions.
4. Satellite Communication Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design Of Down Links, Domestic Satellite Systems Using Small Earth Stations, Uplink Design, Design Of Satellite Link For Specified (C/N). Multiple Access Techniques, Frequency Division Multiple Access (FDMA), TDMA, CDMA, Estimating Channel Requirements, Practical Demand Access Systems, Random Access, Multiple Access With On Board Processing. VSAT
5. Mobile Communications Mobile telephone service, Transmission protocols, Introduction to GSM, GPRS, CDMA, Switching techniques, Fading, Quality of service (QOS).

Books:

1. Advanced Communication Systems - by Wayne Tomasi; Pearson.
2. Digital Communication - by Proakis; PHI
3. Optical Networks - by Uyless Black; Pearson
4. Satellite Communication - by Timothy Pratt; Addison Wesley.
5. Related IEEE/IEE publications