UNIVERSITY OF CALCUTTA

Notification No. CSR/ 16 /14

It is notified for the information of all concerned that in terms of the provisions of Section 54 of the Calcutta University Act, 1979, (as amended), and, in exercise of his powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 30.04.2014, approved the Revised Regulations, Course Structure and detailed Syllabi for B.Tech. Courses in (i) Radio Physics and Electronics and (ii) Information Technology under this University as laid down in the accompanying pamphlet.

Clause 12(h) of the revised regulations shall take effect from the academic year 2011-12 and onwards.

All the other items in the revised regulations, course structures and syllabi shall take effect from the academic year 2012-13 and onwards.

23.05.2014

SENATE HOUSE
KOLKATA-700073
The 23rd May, 2014

(Prof. Basab Chaudhuri)

Registrar

‘FULL-TIME’ 3-YEAR (6-SEMESTER) B. TECH DEGREE PROGRAMMES

OFFERED BY THE

INSTITUTE OF RADIO PHYSICS AND ELECTRONICS
UNIVERSITY OF CALCUTTA

B. Tech Programme 1

B. Tech in Radio Physics and Electronics

B. Tech Programme 2

B. Tech in Information Technology

PROPOSED REVISED REGULATIONS

'Full Time' 3-Year (6-Semester) B. Tech. Degree Programmes offered by the Department of Radio Physics and Electronics University of Calcutta

1	The Department of Radio Physics and Electronics, University of Calcutta offers the following Full-Time 3-Year (6-Semester) Post B. Sc. Courses leading to a B.Tech. degree of the University of Calcutta: **Programme 1 – B. Tech in Radio Physics and Electronics**. **Programme 2 – B. Tech in Information Technology**
2(A)	**Eligibility for Admission:** The minimum qualification for admission to the B. Tech Programmes in the Department of Radio Physics and Electronics of Calcutta University are as follows: (i) A 3-year *B. Sc. Degree (with Honours in Physics with Mathematics as General subject or Honours in Electronics with Physics and Mathematics as General subjects) of Calcutta University or an equivalent degree from any other recognized university,* for admission to Programme 1 (B. Tech in Radio Physics and Electronics). (ii) a 3-year *B. Sc. Degree (with Honours in Physics with Mathematics as a General subject or Honours in Electronics or Computer Science with Physics and Mathematics as General subjects) of Calcutta University or an equivalent degree from a recognized university,* for admission to Programme 2 (B. Tech in Information Technology.
2(B)	The duration of the Programmes will be divided into 6 Semesters, each of 6 months duration.
3	Admission of the candidates to the programmes will be as per Calcutta University norms.
4	The academic programme to be pursued during the B.Tech. Course will have the following components: **(**i) Theory/Laboratory based papers comprising Lectures (L), Tutorials (T) and Practicals (P). (iii) Compulsory Project Work in Two parts: Foundation and Final. (v) General Viva Voce**.** Note: The number of papers to be offered and the Credit distribution thereof can be found from the detailed Course Structures.
5	Each paper will carry "**CREDITs**" according to the number of hours devoted per week as indicated in the following table. **Paper** **Hrs/week** **Credits assigned** **Lectures (L)** **1** **1** **Tutorials (T)** **1** **1** **Practical (P)** **3** **2**
6	The number of Lecture, Tutorial and Practical hours/week assigned to each paper as well as the Project Work of the Course, and the Credits thereof will be determined from the Structure of the Course in conjunction with the Table in Item 5.
7	The Total Credits of the B.Tech. Programmes will be 150. The Semester-wise

	distribution of credits will be as per the respective Course Structures
8	The examinations for B.Tech. Courses shall be held in 6 parts. At the end of each Semester, an examination of the Papers/Project Work covered in that Semester will be held. This examination will be referred to as the **B. Tech Examination of the corresponding Semester**. *The study break between the completion of regular classes and the commencement of the Semester Examination will generally be of 10 calendar days.* The schedule of a Semester examination and the credits to be earned will be in accordance with the Course structure. ***A student earns the credits assigned to a Paper or to Project/Thesis Work (Foundation/Final) or to General Viva Voce, when he/she satisfies the performance criteria stated below in Item 10.***
9	(a) Examination of a Theoretical (Lecture) component of a paper carrying 3 credits or less will ordinarily be of 2 hour duration. (b) Paper Setters and Examiners for Theoretical component of a paper will be appointed from a Board of Examiners consisting of all the faculty members of the Department and the Honorary/Guest Lecturers, if any. (c) Evaluation of the Tutorial component of a paper will be based on sessional evaluation based on assignments and/or mid-semester examination, by the Faculty member(s) offering the course. (d) Evaluation of performance in the Practical (P) component of a Paper will be based on Sessional work in that paper, Lab Report and an end-semester viva voce. On completion of all the experiments in the Lab, a student will be given marks, out of notional full marks, according to the following allocations. (i) 50% for experiments performed in the lab – the Sessional work to be evaluated by the Teacher-in-Charge. (ii) 40% for Viva Voce on the experiments to be conducted by a Board consisting of the Teacher(s)-in-Charge and an External Examiner and / or another Faculty member of the Department. (iii) 10% for Lab Report to be evaluated by the Viva Voce Board.
10	(a) The performance of a student in a Paper, Project Work and General Viva Voce will be evaluated in terms of '**Grades**' and '**Grade Points**' earned by the student. The equivalence between 'Grade', 'Grade Point' and the Percent Marks (out of notional full marks) is tabulated below. **% of Marks — Grade — Grade-point(P)** **≥ 90% — Ex — 10** **≥ 80% but < 90% — A — 9** **≥ 70% but < 80% — B — 8** **≥ 60% but < 70% — C — 7** **≥ 50% but < 60% — D — 6** **< 50% — F — 0** Grade 'F' implies failure to earn the corresponding credits. Grades higher than 'F' and GP ≥ 6 indicate successful clearing of a unit that will earn the student the corresponding Grade Point (P) and the Credits (C) assigned to that unit. (b) The '% of Marks' earned by a student in a paper consisting of 'L', 'T' and 'P' components will be evaluated from the following formula: $\%\ of\ Marks = \frac{C_L M_L + C_T M_T + C_P M_P}{C_L + C_T + C_P}$

where, C_L, C_T, C_P are respectively the Credits assigned to the Lecture, Tutorial and Practical components of the paper and M_L, M_T, M_P are respectively the percentage marks (calculated from the notional full marks) obtained by the student in the corresponding components of that paper.

(c) The overall performance of a candidate in a particular (j th, j=1,2,3,4,5,6) Semester examination, who earns all the credits of that Semester in one chance, will be assessed by the **Semester Grade Point Average (SGPA) 'S'** to be computed from

$$SGPA^{(j)} = \frac{\sum_i P_i^{(j)} C_i^{(j)}}{\sum_i C_i^{(j)}} \qquad \text{(I)}$$

where the summations are over the Grade Points and Credits earned in the examination of the j th Semester. C_i denotes the total credits (L/T/P components combined) associated with a Paper or Seminar or Project Work (Foundation or Final) or General Viva Voce and P_i would be the corresponding Grade Points earned. $\sum_i C_i^{(j)}$ is the total credit of the j th Semester and $\sum_i P_i^{(j)} C_i^{(j)}$ is the weighted sum of the Grade Points earned in the j th Semester.

(d) On completion of the B. Tech. Course (when 150 credits have been earned as per regulations), the final result of a candidate will be shown through the **Cumulative Grade Point Average (CGPA)**.

CGPA will be computed from

$$CGPA = \frac{\sum_{j=1}^{N} S^{(j)} \cdot C^{(j)}}{\sum_{j=1}^{N} C^{(j)}} = \frac{\sum_{j=1}^{N} S^{(j)} \cdot C^{(j)}}{150} \qquad \text{(II)}$$

where, N is the total number of semesters in the Programme (N = 6 for the B. Tech Programmes) for a student who earns the total credits of the Course in single chance (consecutive semesters without back credits during the course of study); and from

$$CGPA = \frac{\sum_k P_k \; C_k}{150} \qquad \text{(III)}$$

for a student who completes the B.Tech. Course in 6 Semesters but with back credits during the course of study or in more than 6 Semesters as per regulations, where P_k is the Grade Points earned in the k^{th} unit carrying C_k credits and the summation is over all the units: All the Papers, Project Work and General Viva Voce of the B. Tech Course.

	(e) Where 'Percentage (%) Marks' is required instead of 'CGPA', an equivalent percentage marks may be computed using the approximate formula: Percentage (%) Marks = (CGPA – 0.5) X 10 For computing the Percentage (%) Marks of any individual semester the same formula may be used with 'CGPA' being replaced by the 'SGPA' of that particular semester.
11	(a) Each student will be allotted the topic of the Project Work at the beginning of the 5th Semester of the programmes. He/she will have to carry out the Project Work under (i) the supervision of a Faculty member of the Department or (ii) the joint supervision of more than one Faculty members of the Department or (iii) the joint supervision of one or more Faculty members of the Department and an External Superviser, who is a Faculty member/Scientist/Technologist of another institution/organization. The programme under joint supervision will have to be approved by the BPGS in RPE. (b) At the end of the 5th Semester or the Semester in which a student pursues the Project Work (Foundation), he/she will have to submit, through the respective Superviser(s), a Report on Project Work (Foundation) and defend the same in a viva-voce to be conducted by a Board of Examiners consisting of the Faculty members of the Department. (c) For Foundation Project Work, 60% of the notional full marks will be set aside for the Sessional Work and 40% for the Viva Voce. (d) At the end of the 6th Semester or the Semester in which the student pursues the Project Work (Final), he/she will have to submit, through the respective Superviser(s), a dissertation on the Project Work (Final) and defend the same in a viva-voce. The evaluation of the Dissertation and the viva-voce will be conducted by a Board of Examiners to be constituted by the BPGS in RPE from the Faculty members of the Department, External Superviser(s) and External Examiner(s). (e) The Project Work (Foundation) and/or the Project work (Final) or both can be undertaken in an organization/institution other than the Department of RPE as a programme under joint supervision (clause 11(a)(iii)).
12	(a) The classes of 2nd Semester onward will begin immediately after the completion of the previous Semester examinations. (b) A student who fails to earn the total credits of the 1st, 2nd, 3rd , 4th and 5th Semesters, at the first appearance in the Semester examinations, will be allowed to continue in the next Semester, provided he/she did not fail to earn the credits of more than 2 (two) papers in that semester examination. (c) If a student fails to earn the credits of more than 2 (two) papers in each of 1st, 2nd, 3rd, 4th and 5th Semester examinations, he/she will be deemed to have failed in that Semester examination. (d) A student will have to earn the credits of the Project Work (Foundation) in the 5th Semester examination in order to be promoted to the next Semester to pursue the Project Work (Final). (e) In order to clear the Project Work (Final) of the 6th Semester, a student will have to earn the total credits assigned to the Project Work of the Semester in a single chance. (f) A student who fails in a Semester examination (clauses: 12(c), (d)) or fails to appear

	in a Semester examination, will not be allowed to continue in the next Semester and will have to revert back to the same Semester in the next Academic Session. (g) The due-to-earn or 'back' credits of a Semester will have to be earned in the examination of the same Semester of the next academic session. The candidate will have 2 (two) such additional chances (a total of 3 chances including the first) to earn the due credits. (h) After publication of the results of the 5th Semester examination, if any student is found to have un-cleared 'back' credits, for which he/she has valid available chances to clear including any such 'back' credits in the 5th Semester examination, a special supplementary examination will be arranged for those students to clear the un-cleared 'back' credits of the odd-semester examinations only. This supplementary examination will be counted as one of the two additional chances mentioned in clause 12(g) above. (i) In order to complete the B.Tech. course, a student will have to utilize all the allowed chances within 5 years or 5 consecutive academic sessions or 10 consecutive Semesters, from the date of the first admission. (j) For a student who fails to earn the total credit of a Semester but gets promoted to the next Semester by virtue of clause 12(b), it would be necessary that the total un-cleared 'back' credits carried by the student at any stage does not exceed that of 5 (five) papers. If at the end of any Semester, the accumulated back credit of a student exceeds that of 5 papers, the student will not be permitted to pursue the course further.
13	(a) At the end of each Semester examination other than the final semester, the Syndicate will publish separate lists of following candidates. (i) One list will show the results of the candidates who earned all the Semester credit in one (first) chance and are allowed to continue in the next Semester. This list will also show the SGPA earned by the candidates as computed from formula (I) in clause 10(c). (ii) Another list will show the results of the candidates who did not earn all the credits of the Semester but earned the credits of the required number of papers in the first chance to be allowed to continue in the next Semester. The SGPA of such a candidate for the particular Semester examination will not be computed (hence not shown). (iii) A third list will show the results of the candidates who appeared in the Semester examination only for earning back credits. (b) At the end of the 6th Semester examination, the Syndicate shall publish the following separate lists: (i) One list will show the results of the candidates who earned all the credits of the Semester in one (first) chance. This list will also show the SGPA earned by the candidates as computed from formula (I) in clause 10(c). (ii) One list will show the results of the candidates who could not earn all the credits of the Semester and hence 'failed' in the Semester examination according to clause 12(e). (iii) One list will show the results of the candidates who appeared in the Semester examination only to earn back credits. (iv)One list will show the candidates, who earned the total credits of the B.Tech. course in one chance (without any back credits in any Semester during the course of study), in order of merit, on the basis of the combined results of all the Semester examinations. The list will also show the CGPA (computed from Formula II of clause 10(c)) earned by the candidates. (v) A list of candidates who completed the B.Tech. course in consecutive Semesters but with back credits during the course of study. In such cases, CGPA will be computed from formula III of clause 10(c). (c) A candidate who completes the B.Tech. Course in the specified number of Semesters but with back credits or in more than the specified number of Semesters, will be deprived

	of his/her position in order of merit but will be awarded the CGPA he/she earns, computed from formula (III) of clause 10(c). (d) A Consolidated Grade Sheet, showing the combined results of all the Semester examinations of the B.Tech. Course will be issued to a candidate after he/she earns the total credits of the Course. The two categories of candidates, defined in clauses 13(b)(iv)-(v), will be issued the Consolidated Grade Sheet together with the Final Semester Grade Sheet. Those who complete the Course in more than the specified number of Semesters within the allowed chances will have to apply for the Consolidated Grade Sheet by submitting copies of all his/her Semester Grade Sheets. (e) A candidate may apply for review of the theoretical component of papers of a semester examination by depositing the fees prescribed by the University. The application must be made within one month from the date of publication of the results of that semester. The maximum number of papers for review in a semester examination for a student will be restricted to two.
14	In order to be able to appear in a Semester examination, a candidate shall have to pursue a regular course of studies in the Semester and attend at least 65% of the total Theoretical (including Tutorials) and total Practical classes separately in the Semester. For the Project work, both Foundation and Final, a certificate of satisfactory attendance would have to be obtained from the Supervisor(s) prior to registration for the Semester examination. A candidate who fails to earn the total credits of a Semester in the first appearance in the Semester examination, but gets promoted to the next Semester by virtue of satisfying the clause 12(b), will not be required to attend classes in the 'back' paper(s).

Proposed Revised Structure of 3-year (6-semester) B. Tech Course in Radio Physics and Electronics

Sl. No.	Semester – I	L	T	P	Credit
1.	RP1.1.1 – Analytical and Numerical Methods	3	2	0	5
2.	RP1.1.2 – Network Analysis	3	1	0	4
3.	RP1.1.3 – Electromagnetic Fields and Radio Wave Propagation	3	0	0	3
4.	RP1.1.4 – Solid State Electronics and Devices	3	1	0	4
5.	RP1.1.5 – Signals and Systems	3	0	3	5
6.	RP1.1.6 – Circuit Elements and Measurements	0	0	3	2
7.	RP1.1.7 – Programming Language	0	2	3	4
8.	RP1.1.8 – Workshop Practice	0	0	3	2
				Total Credit:	**29**

Sl. No.	Semester – II	L	T	P	Credit
1.	RP1.2.1 – Communication Systems	3	0	0	3
2.	RP1.2.2 – Logic and Switching Circuits	3	1	3	6
3.	RP1.2.3 – Active Circuits	3	0	0	3
4.	RP1.2.4 – Transmission Lines, Wave Guides, and Antennas	3	0	0	3
5.	RP1.2.5 – Analog Circuits and Simulation	3	0	3	5
6.	RP1.2.6 – Antenna Measurements	0	1	3	3
7.	RP1.2.7 – Engineering Drawing	0	0	3	2
				Total Credit:	**25**

Sl. No.	Semester – III	L	T	P	Credit
1.	RP2.1.1 – Digital Techniques	3	1	0	4
2.	RP2.1.2 – Computer Organization and Architecture	3	0	0	3
3.	RP2.1.3 – Analog Instrumentation and Measurements	3	0	0	3
4.	RP2.1.4 – Network Synthesis and Transmission Networks	3	1	0	4
5.	RP2.1.5 – Electrical Machines and Power Electronics	3	0	0	3
6.	RP2.1.6 – Control Systems	3	0	0	3
7.	RP2.1.7 – Digital Technique Experiments	0	0	3	2
8.	RP2.1.8 – Communication Techniques	0	0	3	2
9.	RP2.1.9 – Solid State Device Measurements	0	0	3	2

10.	RP2.1.10 – Experiments with Electrical Machines	0	0	3	2
			Total Credit:		**28**

Sl. No.	Semester – IV	L	T	P	Credit
1.	RP2.2.1 – Microwave Engineering	3	1	0	4
2.	RP2.2.2 – Digital Communication	3	0	0	3
3.	RP2.2.3 – Microprocessor and Interfacing	3	0	3	5
4.	RP2.2.4 – Principles of Digital Signal Processing	3	0	3	5
5.	Elective 1 Elective I from: RP2.2.5 – Telecommunications RP2.2.6 – Video and Multimedia Techniques	3	0	0	3
6.	RP2.2.7 – Digital Communication Experiments	0	0	3	2
7.	RP2.2.8 – Microwave Circuits Experiments	0	0	3	2
			Total Credit:		**24**

Sl. No.	Semester – V	L	T	P	Credit
1.	RP3.1.1 – Material Science and Technology	3	0	0	3
2.	RP3.1.2 – VLSI Design	3	0	0	3
3.	RP3.1.3 – Mobile and Satellite Communications	3	0	0	3
4.	RP3.1.4 – Digital Instrumentation and Measurements	3	0	0	3
5.	RP3.1.5 – Radar and Navigational Electronics	3	0	0	3
6.	Elective II One Elective from: RP3.1.6 – Microwave Antennas RP3.1.7 – Data Structures and Algorithms RP3.1.8 – Heterostructure Devices	3	0	0	3
7.	RP3.1.9 – VLSI Design Methodology	0	0	3	2
8.	RP3.1.10 – Optical Communication Experiments	0	0	3	2
9.	RP3.1.11 – Instrumentation and Measurements	0	0	3	2
10.	RP3.1.12 – Foundation of Project Work	0	0	3	2
			Total Credit:		**26**

Sl. No.	Semester – VI	L	T	P	Credit
1.	RP3.2.1 – Economics and Management	3	0	0	3
2.	RP3.2.2 – High Frequency and Optoelectronic Devices	3	1	0	4
3.	RP3.2.3 – Optical Communication and Networking	3	0	0	3
4.	RP3.2.4 – General Viva-voce	0	0	0	2
5.	RP3.2.5 – Project Work	0	0	9	6

Total Credit: 18

Proposed Revised Structure of 3-year (6-semester) B. Tech Course in Information Technology

Sl. No.	Semester – I	L	T	P	Credit
1.	RP1.1.2 – Network Analysis	3	1	0	4
2.	RP1.1.4 – Solid State Electronics and Devices	3	1	0	4
3.	RP1.1.5 – Signals and Systems	3	0	3	5
4.	RP1.1.7 – Programming Language	0	2	3	4
5.	RP1.1.8 – Workshop Practice	0	0	3	2
6.	RP1.1.9 – Web Design	0	0	3	2
7.	RP1.1.10 – Discrete Mathematics	3	1	0	4
8.	RP1.1.11 – Transmission Engineering	3	0	0	3
			Total Credit:		**28**

Sl. No.	Semester – II	L	T	P	Credit
1.	RP1.2.2 – Logic and Switching Circuits	3	1	3	6
2.	RP1.2.3 – Active Circuits	3	0	0	3
3.	RP1.2.5 – Analog Circuits and Simulation	3	0	3	5
4.	RP1.2.7 – Engineering Drawing	0	0	3	2
5.	RP1.2.8 – System Administration	0	1	3	3
6.	RP1.2.9 – Data Structure-1	3	1	0	4
7.	RP1.2.10 – Operating System	3	0	0	3
			Total Credit:		**26**

Sl. No.	Semester – III	L	T	P	Credit
1.	RP2.1.1 – Digital Techniques	3	1	0	4
2.	RP2.1.2 – Computer Organization and Architecture	3	0	0	3
3.	RP2.1.7 – Digital Technique Experiments	0	0	3	2
4.	RP2.1.11 – Communication Techniques Lab	0	1	3	3
5.	RP2.1.12 – Computer Network Experiments	0	0	3	2
6.	RP2.1.13 – RDBMS Design	0	0	3	2
7.	RP2.1.14 – RDBMS	3	0	0	3
8.	RP2.1.15 – Data Structure-II	3	1	0	4
9.	RP2.1.16 – Algorithms	3	1	0	4
10.	RP2.1.17 – Computer Networking	3	0	0	3
			Total Credit:		**30**

Sl. No.	Semester – IV	L	T	P	Credit
1.	RP2.2.2 – Digital Communication	3	0	0	3
2.	RP2.2.3 – Microprocessor and Interfacing	3	0	3	5
3.	RP2.2.4 – Principles of Digital Signal Processing	3	0	3	5
4.	RP2.2.5 – Telecommunications	3	0	0	3
5.	RP2.2.7 – Digital Communication Experiments	0	0	3	2
6.	Elective 1	3	0	0	3
7.	Elective 1I	3	0	0	3
	Elective I and Elective II from: RP2.2.6 – Video and Multimedia Techniques RP2.2.9 – Instrumentation and Control RP2.2.10 – Computer Graphics RP2.2.11 – Image Processing and Computer Vision RP2.2.12 – Formal Language and Automata Theory				
			Total Credit:		**24**

Sl. No.	Semester – V	L	T	P	Credit
1.	RP3.1.1 – Material Science and Technology	3	0	0	3
2.	RP3.1.2 – VLSI Design	3	0	0	3
3.	RP3.1.3 – Mobile and Satellite Communications	3	0	0	3
4.	Elective III	3	0	0	3
5.	Elective IV	3	0	0	3
	Elective III and Elective IV from: RP3.1.15 – Pattern Recognition RP3.1.16 – Parallel and Distributed Computing RP3.1.17 – Data Mining RP3.1.18 – Advanced Communication Systems RP3.1.19 – Mobile Computing RP3.1.20 – Artificial Intelligence and Robotics				
6.	RP3.1.9 – VLSI Design Methodology	0	0	3	2
7.	RP3.1.10 – Optical Communication Experiments	0	0	3	2
8.	RP3.1.12 – Foundation of Project Work	0	0	3	2
9.	RP3.1.14 – Java Programming	2	0	3	4
			Total Credit:		**25**

Sl. No.	Semester – VI	L	T	P	Credit
1.	RP3.2.1 – Economics and Management	3	0	0	3
2.	RP3.2.3 – Optical Communication and Networking	3	0	0	3
3.	RP3.2.4 – General Viva-voce	0	0	0	2
4.	RP3.2.5 – Project Work	0	0	9	6
5.	RP3.2.6 – Software Engineering	3	0	0	3
			Total Credit:		**17**

List of Papers offered in B.Tech. courses by the Department of Radio Physics and Electronics

Paper	Description	L	T	P	Credit
RP1.1.1	ANALYTICAL AND NUMERICAL METHODS	3	2	0	5
RP1.1.2	NETWORK ANALYSIS	3	1	0	4
RP1.1.3	ELECTROMAGNETIC FIELDS AND RADIO WAVE PROPAGATION	3	0	0	3
RP1.1.4	SOLID STATE ELECTRONICS AND DEVICES	3	1	0	4
RP1.1.5	SIGNALS AND SYSTEMS	3	0	3	5
RP1.1.6	CIRCUIT ELEMENTS AND MEASUREMENTS	0	0	3	2
RP1.1.7	PROGRAMMING LANGUAGE	0	2	3	4
RP1.1.8	WORKSHOP PRACTICE	0	0	3	2
RP1.1.9	WEB DESIGN	0	0	3	2
RP1.1.10	DISCRETE MATHEMATICS	3	1	0	4
RP1.1.11	TRANSMISSION ENGINEERING	3	0	0	3
RP1.2.1	COMMUNICATION SYSTEMS	3	0	0	3
RP1.2.2	LOGIC AND SWITCHING CIRCUITS	3	1	3	6
RP1.2.3	ACTIVE CIRCUITS	3	0	0	3
RP1.2.4	TRANSMISSION LINES, WAVE GUIDS, AND ANTENNAS	3	0	0	3
RP1.2.5	ANALOG CIRCUITS AND SIMULATION	3	0	3	5
RP1.2.6	ANTENNA MEASUREMENTS	0	1	3	3
RP1.2.7	ENGINEERING DRAWING	0	0	3	2
RP1.2.8	SYSTEM ADMINISTRATION	0	1	3	3
RP1.2.9	DATA STRUCTURE - I	3	1	0	4
RP1.2.10	OPERATING SYSTEM	3	0	0	3
RP2.1.1	DIGITAL TECHNIQUES	3	1	0	4
RP2.1.2	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3
RP2.1.3	ANALOG INSTRUMENTATION AND MEASUREMENTS	3	0	0	3
RP2.1.4	NETWORK SYNTHESIS AND TRANSMISSION NETWORKS	3	1	0	4
RP2.1.5	ELECTRICAL MACHINES AND POWER ELECTRONICS	3	0	0	3
RP2.1.6	CONTROL SYSTEMS	3	0	0	3
RP2.1.7	DIGITAL TECHNIQUE EXPERIMENTS	0	0	3	2
RP2.1.8	COMMUNICATION TECHNIQUES	0	0	3	2
RP2.1.9	SOLID STATE DEVICE MEASUREMENTS	0	0	3	2
RP2.1.10	EXPERIMENTS WITH ELECTRICAL MACHINES	0	0	3	2
RP2.1.11	COMMUNICATION TECHNIQUES LAB	0	1	3	3
RP2.1.12	COMPUTER NETWORK EXPPERIMENTS	0	0	3	2
RP2.1.13	RDBMS DESIGN	0	0	3	2
RP2.1.14	RDBMS	3	0	0	3
RP2.1.15	DATA STRUCTURE - II	3	1	0	4

RP2.1.16	ALGORITHMS	3	1	0	4
RP2.1.17	COMPUTER NETWORKING	3	0	0	3
RP2.2.1	MICROWAVE ENGINEERING	3	1	0	4
RP2.2.2	DIGITAL COMMUNICATION	3	0	0	3
RP2.2.3	MICROPROCESSOR AND INTERFACING	3	0	3	5
RP2.2.4	PRINCIPLES OF DIGITAL SIGNAL PROCESSING	3	0	3	5
RP2.2.5	TELECOMMUNICATIONS	3	0	0	3
RP2.2.6	VIDEO AND MULTIMEDIA TECHNIQUES	3	0	0	3
RP2.2.7	DIGITAL COMMUNICATION EXPERIMENTS	0	0	3	2
RP2.2.8	MICROWAVE CIRCUITS EXPERIMENTS	0	0	3	2
RP2.2.9	INSTRUMENTATION AND CONTROL	3	0	0	3
RP2.2.10	COMPUTER GRAPHICS	3	0	0	3
RP2.2.11	IMAGE PROCESSING AND COMPUTER VISION	3	0	0	3
RP2.2.12	FORMAL LANGUAGE AND AUTOMATA THEORY	3	0	0	3
RP 3.1.1	MATERIALS SCIENCE AND TECHNOLOGY	3	0	0	3
RP3.1.2	VLSI DESIGN	3	0	0	3
RP3.1.3	MOBILE AND SATELLITE COMMUNICATIONS	3	0	0	3
RP3.1.4	DIGITAL INSTRUMENTATION AND MEASUREMENTS	3	0	0	3
RP3.1.5	RADAR AND NAVIGATIONAL ELECTRONICS	3	0	0	3
RP3.1.6	MICROWAVE ANTENNAS	3	0	0	3
RP3.1.7	DATA STRUCTURES AND ALGORITHMS	3	0	0	3
RP3.1.8	HETEROSTRUCTURE DEVICES	3	0	0	3
RP3.1.9	VLSI DESIGN METHODOLOGY	0	0	3	2
RP3.1.10	OPTICAL COMMUNICATION EXPERIMENTS	0	0	3	2
RP3.1.11	INSTRUMENTATION AND MEASUREMENTS	0	0	3	2
RP3.1.12	FOUNDATION OF PROJECT WORK	0	0	3	2
RP3.1.13	ELECTRONIC DESIGN AND SIMULATION	0	0	3	2
RP3.1.14	JAVA PROGRAMMING	2	0	3	4
RP 3.1.15	Pattern Recognition	3	0	0	3
RP3.1.16	PARALLEL AND DISTRIBUTED COMPUTING	3	0	0	3
RP3.1.17	DATA MINING	3	0	0	3
RP3.1.18	ADVANCED COMMUNICATION SYSTEMS	3	0	0	3
RP3.1.19	MOBILE COMPUTING	3	0	0	3
RP3.1.20	ARTIFICIAL INTELLIGENCE AND ROBOTICS	3	0	0	3
RP3.2.1	ECONOMICS AND MANAGEMENT	3	0	0	3
RP3.2.2	HIGH FREQUENCY AND OPTOELECTRONIC DEVICES	3	1	0	4
RP3.2.3	OPTICAL COMMUNICATION AND NETWORKING	3	0	0	3
RP3.2.4	GENERAL VIVAVOCE	0	0	0	2
RP3.2.5	PROJECT WORK	0	0	9	6
RP3.2.6	SOFTWARE ENGINEERING	3	0	0	3

Detailed Syllabi of papers offered for the B.Tech courses by the Dept. of Radio Physics and Electronics

RP1.1.1 - ANALYTICAL AND NUMERICAL METHODS (3 2 0)

Linear Algebra: Vector spaces – dimensions and basis, sub-space of a vector space; Matrix – Algebraic operations, row space and column space, partitioning, inverse, rank, trace, Hermitian and Skew Hermitian, Triangular matrix (Lower, Upper and Tridiagonal); Solution space of linear equations, nullity of a matrix, eigenvalue and eigenvector problems, applications – coordinate transformation in two and three dimensions, vector transformation, characteristic value problems; Numerical computation of inverse, rank, trace, eigenvalue and eigenvector; Numerical solution of system of linear equations – Gauss elimination, Gauss-Jordan reduction, Gauss-Seidal iteration, ill condition, pivot.[6]

Nonlinear Algebraic Equations: Methods for finding real roots – Bisection, Regula-falsi, Modified Regula-falsi, Secant, Newton-Raphson; Methods of finding real and complex roots – Graefee's and Newton's techniques; system of nonlinear equations. [4]

Function of Complex Variables: Concept of Argand diagram; Cauchy-Riemann equation for existence of derivatives; Line integration – Cauchy's integral theorem, contour integration, Cauchy's integral formula; Infinite series – Taylor and Laurent's series; concept of poles and zeroes, Residue theorem – application in evaluating integrals; Conformal mapping – Schwartz-Christoffel transformation, applications to electrostatic potential; Solution of differential equation by contour integration, Numerically computing elliptic integral and evaluating elliptic functions. [6]

Statistics and Probability: Sample space – frequency distribution, sample mean and variance; Random sampling – probability, random numbers and its generation algorithms, Chi-square test for randomness, Binomial, Poisson and Normal distributions, Four moments method for calculation of distribution; Monte Carlo method – its applications; Regression and correlation analysis, Curve fitting – the methods of least squares, splines and cubic splines; Optimization technique – linear programming, Simplex methods. [6]

Interpolation: Finite Difference operators and their algebra, Fundamental equations satisfied by the operators, Gregory-Newton interpolation formula, Differentiations and Integrations of tabulated function; Difference table; Polynomial Interpolation (Newton forward, Newton backward, Stirling's and Bessel's), differentiation and integration; of Lagrange's Interpolation, neviel's algorithm, integration by Gauss quadrature formula; Finite Difference Equations (FDE) and its numerical solutions. [8]

Numerical Solution of Differential Equations: Numerical method for solution of first order differential equations – Euler's method, Modified Euler's method, Taylor Series method, Runge-Kutta method; Numerical solution of second order differential equations; Numerical solution of partial differential equations – elliptic, parabolic and hyperbolic equations.
[6]

RP1.1.2 - NETWORK ANALYSIS (3 1 0)

Circuit Elements and Sources: Classification; Independent and controlled Sources; Response of circuit elements for various excitation wave forms; Sinusoidal excitation; Average and reactive power; Complex frequency; Immittance; Quality factors of inductors and capacitors; Transformation of voltage and current sources. [4]

Resonance Phenomena: Series resonance; Locus diagrams; Parallel resonance; Universal resonance curve; Bandwidth; Frequency response; Self-resonance of coils; Poles and zeros : circuit behavior from their locations. [4]

Methods of Analysis: Topological description of network; Network variables; Source transformation technique; Generalised mesh and nodal analyses; Constraint equations: Matrix representation; State variable approach; Dual and Inverse networks; Driving - point and transfer impedances. [6]

Graph Theory: Graph of network; Incidence matrix; Cut-set and Tie-set matrices; Network equations. [3]

Network Transformations Network Theorems: Special network configurations; Superposition; Reciprocity; Generalised maximum power transfer theorems; Generalised Thevenin's, Norton's, Millman's and Tellegen's theorems; Applications. [5]

Inductively Coupled Circuits: Identification of relative polarities; Linear transformer; Singly and doubly tuned transformers. [4]

Transient Response of Circuits: Laplace transformation; Transform of linear combinations and damped functions; Shifting, differentiation, integral, initial and final value theorems; Applications; RL, RC, RLC and multimesh circuits; Characteristic equation; Impulse response and transfer function; Convolution integral; s-domain circuit analysis; Time domain response from pole-zero plots; Fourier analysis for periodic signals; Fourier transform; Energy calculation in frequency domain. [7]

Software Packages for Circuit Analysis: Spice and PSpice [2]

RP1.1.3 - ELECTROMAGNETIC FIELDS AND RADIO WAVE PROPAGATION (3 0 0)

Electromagnetic Fields

Review of the Basic E.M. Principles: [5]

Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems

Maxwell's equations: differential and integral forms, displacement current, equation of continuity, boundary conditions

Plane Waves [5]
Wave equation, Poynting vector and power flow, propagation through various media; reflection and refraction; phase and group velocity; skin depth, polarization
Radiation [5]
Radiation concept, retarded potentials, radiation from a Hertzian dipole

Radio Wave Propagation
Temperature and density distribution in the neutral atmosphere, Principal modes of radio wave propagation [3]

Origin and stratification of the ionized atmosphere – formation and properties of a simple Chapman layer, variation of ionization density with solar zenith angle, morphology of different layers of the ionized atmosphere [3]

Propagation of radio waves in an ionized atmosphere – propagation in the absence of magnetic field, condition of reflection from an ionized layer, Appleton-Hartree formula, Radio sounding of the ionosphere [5]

Oblique incidence propagation – equivalence theorems, skip distance
[2]
Signal fading, Scintillations, Diversity techniques [3]

RP1.1.4 - SOLID STATE ELECTRONICS AND DEVICES (3 1 0)
Review of Quantum Mechanics : Wave-particle duality; Schroedinger equation; Meaning of wave function; Simple applications: potential well, potential barrier, tunneling.
Basic Semiconductor Physics : Band structures; Electrons and Holes; E-k relations; Effective mass; Brillouin zone; Density-of-states function; Classifications - Intrinsic, direct and indirect gap, elemental, compound, alloy semiconductors; Heavily doped and amorphous semiconductors. [5]
Semiconductor Statistics : Classical and Fermi-Dirac Statistics; Carrier concentrations under equilibrium; heavily doped semiconductors. [2]
Transport Phenomena : Relaxation time; Scattering mechanisms; Screening; Mobility; Diffusion; Einstein relation; Hall effect and magnetoresistance; Effects of high electric and magnetic fields
Excess Carriers : Method of generation, recombination, lifetime in direct and indirect gap semiconductors; Quasi Fermi level; Continuity equation. [3]
Junction phenomena : Equilibrium contact potential, space charge and depletion capacitance in abrupt, linearly graded and hyperabrupt junctions; Current flow mechanisms and current expression; Minority and majority carrier currents; Transient and ac conduction; Diffusion capacitance; Reverse recovery transients; Breakdown; Deviations from simple theory [5]
Different kinds of Diodes : Schottky barriers; Ohmic contact; Varactor diodes; Tunnel diodes; Gunn diodes; Heterojunction diodes; Zener diodes. [2]
Field Effect Transistors : Metal oxide semiconductor (MOS) capacitors and MOSFETs, band diagram under accumulation, depletion and inversion; threshold voltage and its control; drain current model, output and transfer characteristics, channel length modulation; scaling issues, short channel effects. [10]

RP1.1.5 - SIGNALS AND SYSTEMS (3 0 3)

Introduction : Classification of Signals, Continuous and Discrete Signals, Basic operations on signals, Elementary signals. [4]

Classification of Systems, Properties of Systems [2]

Signal analysis: CT signal analysis: Fourier series, Trigonometric Fourier series, Exponential Fourier series, Fourier Transform, properties of Fourier Transform

Sampling: Sampling Theorem, application of sampling theorem, DFT, FFT

DT signal analysis: DTFS, DTFT [8]

Time domain analysis of LTI Systems: Time domain analysis of CT systems: system response to internal condition, impulse response, system response to external input, convolution, system stability, system behavior.

Time domain analysis of DT systems: system equations, system response to internal condition, impulse response, system response to external input, convolution, system stability, system behavior. [10]

Frequency domain analysis of LTI Systems:

Analysis for CT systems: Laplace transform, properties of the Laplace transform,

Analysis for DT systems: Z-transform analysis, properties of Z- transform. [8]

PRACTICAL

Realization of different types of signals. Solution of Differential Equations.Realization of Convolution. Computation of Fourier Series and Fourier Transform. System analysis. Computation of Laplace transform. Computation of z-transform. Digital Filter design.

RP1.1.6 - CIRCUIT ELEMENTS AND MEASUREMENTS (0 0 3)

Resistor: Measurement of input resistance of a voltmeter, single stage and cascaded attenuator design and measurements

Capacitors: Measurements of audio frequency response of RC circuits with electronic voltmeter, study of pulse response of RC circuits with CRO, integration and differentiation.

Inductors: Experiments on audio frequency and pulse response of RL circuits.

RLC circuits: Audio frequency and pulse response

OPAMP circuits: Comparators, Schmitt Trigger, audio oscillators and Butterworth active filters – design and measurements.

RP1.1.7 - PROGRAMMING LANGUAGE (0 2 3)

Numerical and non-numerical processing with C and Visual Basic language of varying complexity.

Operation with LINUX.

RP1.1.8 - WORKSHOP PRACTICE (0 0 3)

Mechanical Workshop :

Use of Files, Dividers, Punches etc.: Construction of two components out of given metal plate

Use of Bending Machine, Drilling Machine, Band Saw Machine, Hand Shear Machine etc.: Construction of a hexagonal profile of specified dimensions out of a metal plate and drilling hole

at the center, construction of a chassis and panel out of a given metal sheet and fitting the panel on the chassis using machine screws and nuts

Use of Lathe Machine: Making job with taper of given dimensions out of a given round metal rod, knurling a given screw head, preparing an extension shaft, turning, step down turning, surface finishing and square shouldering on a shaft, cutting thread on a given metal rod.

Electronic Workshop :

Construction of an anodized name plate.

Design and construction of small power transformer.

Formation of ohmic contact to n-type Silicon wafers by Electroless Nickel Plating Technique and the use of the same for the fabrication of a silicon point contact diode.

To construct two mutually coupled RF coils and measure their inductances, self capacitances, mutual inductance and self coefficient of coupling and also study the variation of Q of one of the coils with frequency.

Fabrication of Printed Circuit Board**.**

RP1.1.9 - WEB DESIGN (0 0 3)

Internet Fundamentals: Linear and non-linear information. brief introduction and definition of hypertext,URL, http, html, ISOC, IAB, IETF, IRTF, TCP/IP, domain, etc.

HTML elements, tags and attributes, essentials of a web page.

Structuring a web page.

Formatting text in a web page.

Text and image hyperlink.

Ordered and unordered list.

Creating a table.

Designing an application form.

Web page designing using Dreamweaver.

RP1.1.10 - DISCRETE MATHEMATICS (3 1 0)

Set Theory: Sets and Subsets. Null Set and Power Set. Set operations and laws of Set Theory. Counting and Venn Diagram. Cartesian Products. Relations and Ordering. Properties and Representation of Relations, Partition and Covering of Sets, Equivalence Relation, Compatibility Relation, Partial Ordering and Hasse Diagram, Lattice Structure and Boolean Function, Composition of Binary Relations, Functions, Inverse of Functions, Composition of Functions.[5]

Mathematical Logic: Statement and Notation, Connectives, Statement Formula and Truth Tables Conditional and Biconditional, Well Formed Formulas, Tautologies, Functionally Complete Sets of Connectives, Two State Devices and Statement Logic, Normal Form.

[7]

Properties of Integers and Algebraic Structures: The Well Ordering Principle, Principle of Mathematical Induction, Division Algorithm and Prime Numbers, Greatest Common Divisor, Euclidean Algorithm, Fundamental Theorem of Arithmetic, mod Operation, Congruence Relation, Partition of Group – Cosets, Finite fields GF(p^m), Euler's Theorem and Fermat's Little

Theorem, Generation of Binary Codes, Floor and Ceiling Functions, Fibonacci Numbers, Stirling Numbers. [9]

Combinatorics: Principle of Inclusion and Exclusion, The Pigeon Hole Principle, Generating Functions, The Exponential Generating Function, Recurrence Relations, The Method of Generating Functions. [5]

Graph Theory: Graphs and Digraphs, Subgraphs, Complement, Isomorphism, Connectedness and Reachability, Adjacency Matrix, Eulerian Paths and Circuits, Planar Graphs, Hamiltonian Paths and Cycles, Graph Coloring and Chromatic Number, Independence Number and Clique Number, Trees, Minimum Spanning Tree, Rooted Tree, Binary Tree. [10]

RP1.1.11 - TRANSMISSION ENGINEERING (3 0 0)

Elements of Electromagnetic Theory: Maxwell's equations. Wave equations: Plane wave solution in isotropic and homogeneous dielectric media, Concept of Wave Impedance. [4]

High Frequency Transmission Lines: Matched lines and standing waves on unmatched lines, distortion-less line. Impedance matching techniques, Twin-wire and coaxial cables. [4]

Waveguides at Microwave and Optical Frequencies: Modes. Attenuation and power handling characteristics. Excitation of modes. Optical fibres. Types : General features. Transmission media. Limitations – attenuation, dispersion and pulse broadening. [7]

Planar Lines for Microwave and Millimeter-wave Frequencies: Stripline, Microstrip and its variants like Slot line, Fin lines: features and application view points. [3]

Basic Principles of Signal Transmission: Analog and digital transmission. Telegraphy. Telephony. Automatic exchange and Stored Program exchange. Long haul communication. Attenuation and Repeaters. Amplification. 2-wire and 4-wire circuits. FDM and TDM. [6]

Transmission Systems: Coaxial cable transmission. FDM, HDSL and ADSL, PCM-TDM system for digital telephony, Free-space optical transmission, Fibre-optic transmission, Radio-wave propagation, Radio antennas, Tropospheric scatter system, Duct propagation system, Fading and its mitigation, Satellite system. [6]

RP1.2.1 - COMMUNICATION SYSTEMS (3 0 0)

Signals and spectra : Line spectra , average power, Fourier series, aperiodic signals, continuous spectra , Fourier transformation, symmetric and casual signals, proper ties of the unit impulse, step and signum functions, convolution and multiplication, time and frequency convolution, properties of Fourier transformation, time delay and scale change, frequency translation and modulation , differentiation and integration, phasors. [4]

Signal transmission and filtering : Linear time-invariant system, impulse response, superposition integral, transfer function and frequency response, signal distortion in transmission , distortionless transmission , linear distortion , equalization , nonlinear distortion and companding, filters and filtering, ideal filters, pulse response and rise time, quadrature filters and Hilbert transforms, correlation and spectral density, correlation of power signals, correlation of energy signals, input-output correlations , Parseval's power theorem, spectral density functions, W-K theorem. [5]

Linear CW modulation and demodulation : Bandpass signals , amplitude modulation, DSB-SC modulation , SSB-SC and VSB modulation balanced modulator , ring modulator, AM detectors, envelope detection , practical diode detector, synchronous detector. [5]

Exponentional CW modulation and demodulation: Phase and frequency modulation , single tone and multi-tone frequency modulation, transmission bandwith, generation and demodulation of FM/PM signals , narrowband and wideband FM, varactor diode modulator, reactance modulator, Foster-Seely discriminator, ratio detector, PLL and FM detection. [6]

Radio communication system: AM transmitters, broadcast transmitters, power amplifiers, cooling of transmitters devices, radio telephony transmitters. SSB transmitters, FM transmitters. [3]

Radio receivers: TRF and superheterodyne receivers , AM broadcast receivers , RF amplifier, mixer, IF amplifier, detector, AGC and tone control, communication receivers selectivity, noise limiter, squelch, AFC, tuning indicator, volume expander, SSB receivers, FM receivers, measurement of receiver performance. [4]

Noise: Classification and origin of noise, thermal noise, noise power spectral density and available power, white noise, coloured noise, equivalent temperature, noise figure, noise bandwidth, signal transmission in the presence of noise, noise in CW modulation system, pre-emphasis and de-emphasis. [6]

Information and channel capacity: Measure of information, information content of a message, entropy, information rate, source encoding, error free communication in noisy channels, channel capacity, discrete channel, continuous channels, Shannon-Hartley theorem, bandwidth S/N trade-of f, ideal communication systems. [4]

RP1.2.2 - LOGIC AND SWITCHING CIRCUITS (3 1 3)

Switching and Sampling Circuits: Basic clipper circuits using diodes, transistors, Compensated attenuators, Transistor as switch, Pulse response and switching with inductive and capacitive loads, Non-saturating switches, Sample-and-Hold circuits [6]

Logic Families: Basic logic gates, TTL, ECL and CMOS logic – Transfer characteristics, Noise and noise margin, Tri-state logic, Wired logic – Open collector/drainonfiguration, Propagation delay. [6]

Boolean Function Simplication and Logic Design : Logic minimization – Map and tabulation methods, Combinational logic design – Using universal gates, Multiplexers / Demultiplexer. [6]

Programmable Logic Devices : PLA/PAL/OPLD, PROM, FPGA, Logic design using PLDs. [6]

Codes and Code Converters : BCD, 8-4-2-1, Excess-3, Gray Code, Errors and error detection codes. [4]

Arithmetic Circuitrs: Binary arithmetic, Half adder, Full adder, Binary parallel and serial adders, Binary subtraction, BCD adder. [4]

RP1.2.3 - ACTIVE CIRCUITS (3 0 0)

1. Introduction: Active and Passive Devices

Classification of electronic components, Differences between active and passive devices, Diode equivalent circuits, Simple diode circuits, clipping, clamping, rectifier. [2]

2. Transistor Biasing and Stabilization

Input-Output Characteristics of CE, CB, CC configuration of BJT, Requirement of DC biasing and operating point, bias stability and stability factors, Fixed bias, Emitter-stabilized bias, self bias etc. [4]

3. BJT Small Signal Analysis and Amplifiers

Concepts of small signal, AC equivalent network, Use of BJT as active devices, concepts of input and output impedance, voltage gain and current gain, BJT as two port device and its hybrid model, h parameters, hybrid-pi model and r_e model. Analysis of various transistor amplifier circuits using h-parameters, effects of source and load resistances, Multi-stage amplifiers, differential amplifiers. [8]

4. Frequency Response of BJT

Concepts of decibel, voltage and power gain, Concepts of transfer function, DC Gain, Poles and Zeros, Bode Analysis, Bandwidth, Phase, Low frequency response of BJT amplifier, Miller effect capacitance, High frequency response of BJT amplifier. [3]

5. Feedback Amplifiers

Basic concepts of feedback, transfer gain with feedback, various topologies of feedback amplifiers, Effects of negative feedback, Practical applications of negative feedback strategy [3]

6. Oscillators

Classification of oscillators, criterion for oscillation and feedback oscillator concepts, study and characterization of various practical oscillator circuits, e.g., Hartley, Colpitt, phase-shift, Wien-bridge oscillator, crystal oscillator [4]

7. Power Amplifier

Definition and amplifier types, class A power amplifier, transformer coupled power amplifier, push pull amplifier, class B and class AB power amplifier [3]

8. Integrated Circuits

Operational Amplifier: DC, AC and Transient Characteristics, Use of OPAMPs in various electronic circuits.

Active Filters: low pass, high pass, band pass, band reject and all pass filters. Design of Butterworth, Chebyshev, and Bessel filters [6]

9. Regulated Power Supply

Voltage regulators using zener diodes and BJTs, over voltage and short circuit protection circuits using transistors. [2]

RP1.2.4 - TRANSMISSION LINES, WAVE GUIDS, AND ANTENNAS (3 0 0)

Transmission Lines Fundamentals: Transmission Line Equations; Reflection and Standing Waves on a lossless line; Low loss lines as impedance elements; Techniques of impedance transformation and matching on transmission lines. [5]

Waveguides as Microwave Transmission Lines: Rectangular and Circular waveguides – Modes and Modal characteristics, Attenuation, Power handling capability, Methods of excitation of modes. [4]

Waveguides as Microwave Cavity Resonators: Basic principle and application, Resonant modes and their excitations; Equivalent Circuit; Q-factors. [3]

Printed Transmission Lines: Basic principle and characteristics of Stripline, Microstrip line and its variants, Slotline, Finlines, and Co-Planar Waveguide (CPW). [2]

Waveguides for Millimeterwaves: Surface Waves on impedance planes; Open Dielectric Waveguides – Image guide and its variants; Non-radiating Dielectric (NRD) Guide; H-guide; Groove guide. [2]

Wire Antennas: Half wave dipole and monopole antennas- radiation properties and practical applications; Yagi-Uda arra; Helical antenna; Biconical antenna; Log-periodic dipole array. [4]

Aperture Antennas: Basic characteristics of radiations from aperture, sectoral and pyramidal horn antennas, reflector antennas and various feeding mechanisms. [4]

Antenna Arrays: Principle of linear array and pattern multiplication; uniform array, array with non-uniform excitations. [3]

Printed Antennas: Microstrip radiators- principles, properties, and applications; Printed antennas for mobile and portable wireless equipment. [3]

RP1.2.5 - ANALOG CIRCUITS AND SIMULATION (3 0 3)

Equivalent circuit of MOS transistors: Large signal and small signal MOS device model, low frequency and high frequency equivalent circuits, unity gain current frequency, basic concepts of MOS device noise. [6]

Basic analog subcircuits: MOS switch, MOS diode, active resistor, current source and sink, current mirror, active load. [6]

Single stage IC amplifiers : Common source amplifier with active load, common gate amplifier with active load, common source amplifier with source degeneration, source followers, frequency responses. [6]

Differential and operational amplifiers: MOS Differential pair, small signal operation of MOS differential pair, non-ideal characteristics of differential pair, differential pair with active load, frequency response, two-stage CMOS OTA and OPAMP. [9]

Switched Capacitor Circuits: Resistor emulation, basics of switched capacitor integrator and amplifier. [3]

Voltage Controlled Oscillators: Ring Oscillator, current starved VCO, source coupled VCO. [3]

PRACTICAL

Design of active RC filters: low pass, high pass and band pass filters; determination of the frequency response curve of filters by measurements; modeling of OPAMP and simulation of active RC filters using PSpice; simulation of integrator and differentiator circuits using PSpice, simulation of single stage and two stage RC coupled amplifiers using PSpice

RP1.2.6 - ANTENNA MEASUREMENTS (0 1 3)

Characterization of printed antennas (Resonance and Radiation), measurement of radiation characteristics of circular microstrip antenna, measurement of radiation characteristics of rectangular microstrip antenna, measurement of radiation characteristics of printed Yagi antenna, measurement of radiation characteristics of printed dipole antenna.

RP1.2.7 - ENGINEERING DRAWING (0 0 3)

Use of Drawing Instruments Construction and use of scales; Methods of drawing polygon, parabola, ellipse, helix, spiral, involute of a circle cams. Geometrical Drawing of Solids Plane sections of solids and true shape; Different kinds of threads, rivets and riveted joints, bolts and nuts; Orthographic and isometric drawings of models; Sectional Drawings; Intersections and developments of surfaces. Scale Drawings from Models Pipe fittings; Well bracket; Plummer block; Spur gear; Belt pulley. Scale Drawings of Electrical Apparatus Insulators; Cable connectors; Pole shoe with field coil; Rotor. Drawings of electronic devices, components and integrated circuits; Graphical symbols for electronic circuit diagrams. Sketches of antennas and antenna masts. Drawings of rocket and satellite payloads.

RP1.2.8 - SYSTEM ADMINISTRATION (0 1 3)

Experiments on: User administration. File system administration. Implementation of quota. Mail facility implementation. Interpretation and use of system log.

RP1.2.9 - DATA STRUCTURE-I (3 1 0)

Introduction and Overview: Notion of Data, Data Type, Operation on Data, Representation of Data in Computer Memory, Fundamental Data Type, Aggregate Data Type, Variables, Abstract Data Type, Data Structure, Notion of Algorithm, Efficiency of Algorithm, Algorithmic Notation, Control Structures. [6]

Arrays and Pointers: Definition, Linear Array, Implementation of Linear Array, Operations on Linear Array, Application of Linear Array, Multidimensional Array, Implementation of Multidimensional Array, Pointer, Cursors. [6]

Linked List: Definition. Advantages Over Array, Implementation of Linked List in Computer Memory, Linked List as an Abstract Data Type, Operations on Linked List, Application of Linked List, Memory Allocation, Garbage Collection, Doubly Linked List, Circular Linked List. [8]

Stack: Definition. Implementation of Stack in Computer Memory, Stack as an Abstract Data Type, Operations on Stack, Application of Stack, Arithmetic Expression Evaluation, Recursion, Implementation of Recursion using Stack. [8]

Queues: Definition. Implementation of Queue in Computer Memory, Queue as an Abstract Data Type, Operations on Queue, Application of Queue, Deque, Priority Queue. [8]

RP1.2.10 - Operating System (3 0 0)

Batch Processing System [1]

Multiprogramming Operating Systems: Hardware support for Multiprogramming Storage Protection User Service – Turnaround Time and Job Scheduling. [4]

Processor Management: Job classification and priority. Interrupt processing and program status, Storage Management, Jobs, programs and processes, Job scheduling, Job scheduling performance, Non preemptive scheduling, FCFS scheduling. [10]

Time Sharing Systems: Processor Management – Round robin scheduling. Storage Management. Supporting real time applications. [3]

Analysis of Job Scheduling Policies: Queuing Theory. Client-server model distributed systems. [4]

File and Database Systems: File system functions, Data hierarchy, Blocking and buffering, File organization and access methods, Example hierarchical program construction, Banker's algorithm, Memory management, storage management strategies. [6]

Case Study: CP/M (Control Program for Microcomputers), structure of CP/M, Memory allocation, UNIX O/S, structure of UNIX, Kernel and Shell, File and Directory structure, DOS, files and wildcard characters, elementary commands, Windows 95, Using Windows, Browsing, Explorer, Managing files and folders, Introducing the Internet, Browsing the World Wide Web. [8]

RP2.1.1 - DIGITAL TECHNIQUES (3 1 0)

Multivibrators : Bistable multivibrator using transistor, Monostable and Astable multivibrators using transistors, op-amps and logic gates; Schmitt Trigger circuit, 555 Timer,Multivibrator IC's. [8]

Sequential Circuits : R-S, D, T, J-K flip flops (Level -Triggered, Master-Slave, Edge-Triggered); Conversion between flip-flops Registers (Serial in – Serial out, Serial in – Parallel out, Parallel in – Serial out, Parallel in – Parallel out); Counters (Ripple counter, Synchronous counter, Non-Binary counter, Up-down counters); Analysis and Synthesis of clocked synchronous sequential circuit, Mealy and Moore machine [17]

Memory Devices : Bipolar, unipolar ROM and RAM; Static and dynamic MOS shift registers (two-phase, three-phase, and four-phase shift registers, ratio type, and ratioless shift registers) [7]

D/A and A/D Converters : Weighted resistor and R-2R ladder type D/A converter; Parallel-comparator type; Successive approximation type; Dual slope; Counting A/D converters. [8]

RP2.1.2 - COMPUTER ORGANIZATION AND ARCHITECTURE (3 0 0)

Digital Computer: Introduction; General organization; Functional units; Applications. [2]
Basic Computer Organisation and Design: Computer registers; Register transfer; Micro operations; Bus system; Timing and control signals; Generation of control signals; Instruction cycle; Determination and execution of different types of instructions. [5]
Programming the Basic Computer: Machine Language; Assembly Language; Assembler; Program Loops; Subroutines. [3]
Control Unit: Hard wired and micro - programmed control; Elements of design of control unit from control flow diagram. [3]
Computer Arithmetic and Arithmetic Unit: Signed magnitude representation; Floating point representation of numbers; BCD representation; Addition, Subtraction, Multiplication and Division of numbers in different types of representation. [6]
Central Processing Unit (CPU): General register organisation; Stack organisation; Instruction formats; Addressing modes; Reduced Instruction Set Computer (RISC). [2]
Input/Output: Peripheral devices; Necessity of interfacing; Asynchronous function of I/O and I/O bus; Modes of I/O transfer. [2]
Memory: Memory hierarchy; Main memory; Virtual Memory System. [2]
Pipe Line and Vector Processing: Parallel Processing; Pipelining; Vector processing; Array Processor. [2]

RP2.1.3 - ANALOG INSTRUMENTATION AND MEASUREMENTS (3 0 0)

Electromagnetic Interference Measurement: Introduction - Definition of EMI and EMC; Causes of EMI, effects, practices; Sources of conducted and radiated interference; Shielding and filtering; EMC test plans and procedures; Measurement methods for field strength and for conducted interference; Test equipment and facilities. [6]
Microwave Instruments: Power Meters; Network Analysers. [6]
Operational Amplifier Applications: Instrumentation amplifiers; Isolation amplifiers. [4]
Noise in Measurements: Lock-in-Amplifier [4]

Time Domain Measurements: Cathode Ray Oscilloscope - Cathode Ray Tube; Sweep circuits and synchronisation; Pre-amplifiers and Deflection drivers; Compensation attenuators and CRT probes. Dual and multichannel oscilloscopes; Very high and very low frequency limitations; Sampling and Storage oscilloscopes. [6]
Recorders: X-Y, X-T, X-Y-T. [1]
Instrumentation for Circuit Element Measurements: Curve tracers; Semiconductor parameter analyser. [2]
Frequency Domain Measurements: Harmonic Distortion Analyser; Wave Analyser; Spectrum Analyser (TRF, Heterodyning, Harmonic-heterodyning, Digital). [4]
Signal Generators and Frequency Synthesizer. [2]

RP2.1.4 - NETWORK SYNTHESIS AND TRANSMISSION NETWORKS (3 1 0)

Synthesis of Two-Terminal Reactive Networks: Foster's reactance theorem; Poles and zeros; Separation property; Foster and Cauer Canonic networks. [6]

Synthesis of RL, RC and RLC Networks: RL driving-point impedance and admittance functions; RC driving-point impedance and admittance functions; Foster and Cauer type networks; Synthesis of RLC networks; Hurwitz polynomials; Positive Real Function.[6]
Two-Port Networks: Impedance, admittance, transmission and hybrid parameters; Matrix forms of input-output relations; Cascade, parallel and series connection of two ports; Iterative and image impedances; Characteristic impedance; Propagation function; Balanced and unbalanced networks; Bartlett's bisection theorem and its applications; Nonreciprocal and terminated two-ports. [6]
Special Two-Port Networks: Gyrator; Negative Impedance Converter. [2]
Attenuators: Units of attenuation; Lattice and other special configurations; L-type, ladder and balanced attenuators; Insertion loss; Amplitude and phase equalisers. [4]
Classical Filters: Low-pass, High-pass, Band-pass and Band-elimination filters; Prototype, m-derived and composite filter design; Modern filter design techniques; Approximation method; Butterworth and Chebyshev filters, switched capacitor filters. [6]

RP2.1.5 - ELECTRICAL MACHINES AND POWER ELECTRONICS (3 0 0)

Elements of a power system, transformer, equivalent circuit, electromechanical energy conversion, doubly fed machine, cylindrical machine, torque production, DC machine, AC machine, induction machine, three phase induction machine, equivalent circuit, synchronous machines
Three phase rectifier, controlled rectifier, DC-DC converter, switch-mode DC-AC inverter, switching power supplies, UPS, speed control of DC motor, types of converters, insulated gate bipolar transistor switch

RP2.1.6 - CONTROL SYSTEMS (3 0 0)

Introduction: Notion of feedback; open and closed-loop systems; various types of control system with examples
Modeling and representations: DC generator and servomotor; Block diagram; Reduction of a block diagram to canonical form; signal flow graph and its construction; Mason's gain formula, Different feedback characteristics of control system
Transfer function: Linear time-invariant (LTI) systems; concept and definition of transfer function; zero-state and zero-input response; free and forced responses, Performance indices
Modern control systems – analytical tools: Conventional control vs. modern control; state variable approach; state equations; output equations; state transition matrix; state diagram; relation between transfer function and differential equation; characteristics equation; eigen-values and eigen vectors, Controllability, Observability
Time domain analysis: Test signals; steady state error; error constants and error series; time-domain response; second-order systems; performance criteria
Stability: absolute and relative stability; Routh-Hurwitz criterion; Nyquist stability criteria; Nyquist plot; interpretation of Nyquist plot; gain-margin and phase-margin; Liapunov stability criterion, System with transportation lag

Frequency response analysis: Frequency responses; Bode diagrams; Relative stability and Bode diagram, All pass and minimum phase system
Root locus analysis and design: Root-locus principles; rules for root-locus construction; construction techniques of root-locus; properties of root-locus and root-locus design
Control system design: Gain compensation; pole-zero compensation; phase-lead and phase-lag networks.

RP2.1.7 - DIGITAL TECHNIQUE EXPERIMENTS (0 0 3)

(1) Experiment on TTL NAND gates.
(2) Design and testing of a) half adder circuits b) full adder circuits c) 9's complement generator d) 2 bit digital comparator using NAND gates & 7485IC.
(3) Experiments on multiplexer using 74153.
(4) Experiments on demultiplexer using 74155.
(5) Experiments on a) debounce switch b) seven segment display chips.
(6) Experiment on counter using 7474.
(7) Experiments on Semiconductor memories using 7489.
(8) Experiments on asynchronous counters, shift registers.

RP2.1.8 - COMMUNICATION TECHNIQUES (0 0 3)

Transformer coupled and **Complementary Symmetry** Class B **Power Amplifier**
Modulation and Demodulation: Amplitude modulation and demodulation, double sideband, single sideband, vestigial sideband, frequency modulation and demodulation
Pulse analog modulation: Pulse amplitude modulation, pulse width modulation, pulse position modulation
Radio receivers: Measurement of sensitivity, selectivity, fidelity
Noise measurements: SNR, Noise figure, Power spectral density

RP2.1.9 - SOLID STATE DEVICE MEASUREMENTS (0 0 3)

Experiment on JFET: I-V characteristics, use as VVR (voltage variable resistor), frequency response characteristics

Experiment on MOSFET: I-V characteristics, use in AGC circuit

Experiment on solar cell and LDR: Photodiode characteristics, solar cell I-V characteristics, series resistance of solar cell, fill-factor and efficiency, LDR I-V characteristics, resistance determination
Experiment on SCR: Critical gate-current characteristics, amplitude control circuit to fire SCR
Experiment on UJT: I-V characteristics, UJT parameter estimation, saw-tooth wave generation, firing of SCR using UJT
Experiment on DIAC/TRIAC: Design of a phase-control circuit using RC-circuit, determination of phase angle and control voltage, range of power control, o/p power vs conduction angle

RP2.1.10 - EXPERIMENTS WITH ELECTRICAL MACHINES (0 0 3)

Three Phase Alternator: Determination of the no load saturation curve; Short circuit test; Predetermination of percentage regulation by synchronous impedance method; Study of the variation of field current with load at constant terminal voltage (field characteristic) and hence calculation of percentage regulation.

D. C. Motor: Speed control at no load - Field current control; Armature rheostatic control. Calculation of efficiency from losses, Self-excited D. C. Generator : No load test - Variation of no load voltage with field current at constant R.P.M.; Variation of on load voltage with R.P.M. at constant field current, Study of the variation of field current with load at constant terminal voltage, Determination of voltage characteristic for (i) constant field current and (ii) constant resistance in field circuit.

Single Phase Transformer: Open circuit test; Short circuit test; Predetermination of percentage regulation and efficiency for various loads and power factors.

Three Phase Induction Motor: No load test; Blocked rotor test; Construction of circle diagram and computation of motor performance data.

RP2.1.11 - COMMUNICATION TECHNIQUES LAB (0 1 3)

Introduction of communication system, Basic blocks required.

Modulation, Noise, Multiplexing.

Design of different modulation model using Matlab's simulink environment. Analysis of the performance of modulation in time domain and frequency domain.

RP2.1.12 - COMPUTER NETWORK EXPPERIMENTS (0 0 3)

Communication between clients having different types of addresses like class A IP address, class B IP address and class C IP address

Establishing intra-network communication between different clients having different types of network addresses

Finding MAC addresses of different clients

RP2.1.13 - RDBMS DESIGN (0 0 3)

1. Creation of tables, creation of tables with constraints and validation checks
2. Select queries with different clauses
3. Nested queries
4. Aggregate and order queries
5. Joining of tables
6. Creating views
7. Update, delete and alter tables
8. Creation of procedures, creation of triggers and cursors, fetching data using cursors
9. Designing and generation of reports based on queries

RP2.1.14 - RDBMS (3 0 0)

Database systems: file oriented systems, database systems, hierarchical and network model systems, relational database systems, client-server database systems.

Database systems in the organization: strategic database planning, database development life cycle (DDLC).

Database design: conceptual database design, building conceptual data models from existing reports, aggregation-entity, relationships, ER modeling, EER modeling, data flow diagram (DFDs) .

Relational implementation with SQL and PL/SQL: introduction to SQL, introduction to PL/SQL.

Relational data model: fundamental concepts, normalization process, first normal form, second normal form, third normal form, BCNF and higher normal form, relational algebra, relational calculus.

Physical database systems: physical storage media, disk performance factors, file organization and addressing methods, indexing, B and B+ trees, hashing, mapping logical data structures to physical data structures.

Database administration, transaction and security: overview, DBA functions, database integrity, various aspects of transaction management and concurrency control, database security, database recovery.

Distributed database systems: fundamental concepts, strategies of distributed database systems design.

RP2.1.15 - DATA STRUCTURE - II (3 1 0)

Tree: Terminology, Binary tree – Definitions, Properties, Representations, Traversal, Applications, [4]

Hash Tables: Direct-access tables, Hash tables, Hash functions, Open addressing, [5]

Binary Search Tree: Definition, Searching, Insertion, Deletion, AVL tree, [3]

Heaps: Definition, Maintaining heap property, Building a heap, Heapsort, Priority queue Mergeable heap – binomial heap, [5]

B-Trees: Definitions, Basic operations – creation, insertion, deletions, [3]

Graphs: Definitions, Terminology, Representations; Traversal, Topological sorting, Connected components, [5]

Sorting: Insertion sort, Mergesort, Heapsort, Quicksort, Sorting in linear time – Counting sort, Radixsort, Bucket sort, [5]

RP2.1.16 - ALGORITHMS (3 1 0)

Algorithm Design Paradigms: Incremental. Divide and conquer. Dynamic programming. Greedy. Backtracking. Branch and bound. [5]

Recurrence Relations: Definitions. Methods of solutions – Intelligent guesses, Master theorem, Generating functions. [4]

Selection and Order Statistics: The selection problem. Minimum and maximum. Finding second largest. General selection problem. [5]

Graph Algorithms: Spanning tree. Shortest path. Network flow. [5]

Disjoint Set Manipulation: Disjoint set representation. Disjoint set operations on MEMBER, INSERT, DELETE, UNION, FIND. [4]

String Matching: Elementary algorithm: Rabin – Karp algorithm: KMP algorithm. [5]

Theory of NP Completeness [4]

Approximation Algorithms [4]

RP2.1.17 - COMPUTER NETWORKING (3 0 0)

Module 1: Overview – History, Communication principles (TDM, FDM, Serial & Parallel communication, Simplex, Duplex, Half Duplex), Data communication concepts, Circuit & Packet Switchings, Different types of networks – LAN, MAN & WAN, Need for layered Architecture (OSI & TCP/IP), Protocol Hierarchies and Functions of different layers. [3]

Module -2: Computer Networking principles – Design issues, Data handling by the Data Link Layer and Physical Layer. Framing, Error Detection & Control, Flow Control.[5]

Module – 3: Local Area Network - Introduction, Ethernet, Access Control, Token Rings, FDDI, Wireless 802.11, Advanced Ethernets. [5]

Module – 4: Wide Area Networks – Switching and Forwarding in WAN, Packet Switching, Datagram Forwarding, Virtual Circuit Switching, Source Routing, Circuit Switching, Routing Strategies, Routing Algorithms, Congestion Control Algorithms, Packet Size, External & Internal Connections, Cell Switching or Asynchronous Transfer Mode (ATM), SONET. [7]

Module – 5: Internetworking - Introduction, Service Model, Fragmentation & Reassembly, IP Packet, IP Address, Subnetting, Classless Routing, IP Version 6 (IPv6) [5]

Module – 6: Internet and TCP/IP Protocol Suite - Introduction, TCP Overview, Address Resolution Protocol (ARP), Internet Protocol, Domain Name System (DNS), Transport Protocol, Connection Established by the Transport Layer, The Client-Server Model, Sockets Interface, Socket Addressing, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), API and Socket Programming, End-to-End Protocols.

RP2.2.1 - MICROWAVE ENGINEERING (3 1 0)

Introduction: Microwave engineering – Areas of application (1)

Basic concepts of microwave circuits: Scattering or s-parameter representation of microwave circuits: properties of s-parameters, applications to microwave junctions. (3)

Discrete passive circuit components: Application and design aspects. Matched terminations, attenuators, directional couplers, sliding short tuner, E-H tuner, slide screw tuner, E, H and E-H plane tee, E and H-plane bend, waveguide twist, circulator, isolator, phase shifter, frequency meter, flanges, connectors and adapters. (7)

Integrated circuit components: Applications and design aspects of micro-strip, fin-line, H-guide and dielectric guides. (4)

Sources: Tubes – Klystron, Magnetron, Traveling wave tube, principle of dielectric heating and microwave oven, solid state devices – varacter diode, PIN diode, Schottky diode – features and fields of application, Gunn, IMPATT and MESFET as oscillators and amplifiers, microwave power combiners. (6)

Measurements: Impedance measurement - V.S.W.R method; Reflectometer technique; Use of Smith chart; Bridge method. Detection and measurement of power - Diode detector; Bolometer; Themocouple and calorimeter as microwave power sensors; Balanced and self-balancing bridges. Q-measurement - Transmission method; V.S.W.R method; Transient decay or decrement method; Dynamic methods. Attenuation measurement; Frequency measurement. (9)

RP2.2.2 - DIGITAL COMMUNICATION (3 0 0)

Introduction :

Introduction to Digital Communication , Noise , Advantages & shortcomings of Digital links. Signal and Sampling Theory for Low pass and band pass signals. (2)

Quantization and Coding :

Quantization and preprocessing, Pulse Modulation (PAM,PWM,PPM), Pulse code modulation, Logarithmic Pulse code modulation and Companding, Differential pulse code modulation, Delta Modulation, Digital Multiplexer, TDM –PAM, TDM –PCM, T1 system. (6)

Line Coding :

Line codes, desirable features, line codes in use, UPNRZ,UPRZ,PNRZ,PRZ, Manchester, HDB3, Duo- binary and their spectral characteristics. (4)

Baseband Processing and Transmission :

Baseband signal receiver, matched filter, Regenerative Repeater, Bit synchronization, Frame synchronization, Scrambler,ISI, Eye pattern, Nyquist criterion for Zero ISI, Design of Equalizer, Partial Response Signaling. (6)

Digital Modulation Techniques :

ASK, PSK,FSK,DPSK, CPFSK,MSK,QPSK QAM ,applications. (6)

Spread Spectrum and Multiple Access Techniques :

Introduction to spread Spectrum, PN sequence, DSSS, FHSS, Spread spectrum as a Multiple access Techniques. (6)

Error Control Coding :

Introduction, Linear block codes, Convolution Codes, Coded Modulation Schemes, Trellis code, Turbo Code. (4)

RP2.2.3 - MICROPROCESSOR AND INTERFACING (3 0 3)

Introduction to Microprocessors : Evolution of Microprocessor; Important features; Application. Microprocessor Architecture : Register section; Arithmetic and Logic Unit; Interface section; Timing and control section. (3)

Organisation of the Intel 8085 : MPU Block diagram; Pin description; Generating control signals; Demultiplexing;Address/Data bus; Bus buffering; 8085 Instruction and Timing processes: (5)

Instruction Set and Programming of the 8085 : Data transfer; Arithmetic and Logic operation; Branching; Stack and Subroutines; Input and Output; Problems using Instruction Set: (6)

Interfacing Memory and I/O Devices : The Address Map; Address decoding techniques; Memory interfacing; Design of I/O Ports using MSI and PPI; Keyboard and Display interfacing; DAC and ADC interfacing technique: (6)

Data Transfer Schemes : Introduction; Synchronous transfer; Asynchronous transfer; Interrupt driven data transfer; DMA transfer. Interrupts and Serial Transfer : (3)
The 8085 Interrupts; Multiple Interrupts; Enabling and Masking Interrupts; Device polling. Application Examples : (2)

Organisation of the Intel 8086 : 8086 Internal Architecture; Pin description; (3)
Introduction to Programming: (3)
Interrupt in 8086: (1)
Interfacing memory and I/O devices: (3)
Concept of Multiprocessor: (2)

RP2.2.4 - PRINCIPLES OF DIGITAL SIGNAL PROCESSING (3 0 3)

1. Signals and signal processing, Characterization and classification of signals, Continuous Time Signals and Systems, Discrete Time Signals and Systems, Time Domain representation, Sampling and Reconstruction, Random signals, Frequency response of an LTI Discrete time system, Phase and group delays, Basic sampling rate alteration, Decimator and Interpolator, Polyphase decomposition, Sampling rate converter. [8]

2. Discrete Fourier Transform and its properties (Zero-padding, circular convolution). Fast Fourier Transform-Time decimated Radix-2 FFT, Frequency decimated Radix-2 FFT, z-Transform, ROC. [6]

3. Digital and analog filtering, Digital Filter design considerations - IIR and FIR filters, FIR Filter design by (i) IR truncation, (ii) using windows, IIR Filter design by (i) Impulse invariant method (ii) Bilinear transformation. [8]

4. Digital filter realization and implementation - (i) Direct realization, (ii) cascade realization and (iii) parallel realization, Analysis of finite word length effects, Limit cycles in IIR digital filter. [6]

RP2.2.5 - TELECOMMUNICATIONS (3 0 0)

Basics of Telecommunication: Terminology, Time Frequency and Bandwidth relationship. Telephony, Telegraph, teleprinter, Telex and Fax

Signal and Information: Information and Coding, Modulation, Multiplexing, Difference between analog and digital Transmission.

Basic Transmission system: Telecommunication Media problem, Characterization of communication channels,

Media: Co-axial cable, Microwave, satellite, Fibre Optic

Analog versus digital communication: Wide band Service, Transmission limitation, Noise and Distortion Advantage of digital system

Networking: Network design objective Network classification Schemes: local area networking, Metropolitan area networking, Internet working, Protocol Stacks

Switching: Strowger Switching, Crossbar Switching, Electronic Space Division Switching, Electronic Time division Switching,

Integrated Service Digital networking (ISDN):Network and protocol Architecture, Signalling, Numbering and addressing, Broadband ISDN

RP2.2.6 - VIDEO AND MULTIMEDIA TECHNIQUES (3 0 0)

Picture Analysis and video signals: Vision characteristics, aspect ratio, principles of scanning, interlacing, vertical and horizontal resolution, video bandwidth, synchronization, blanking, composite video signal, picture standards (3)

Television Principles: Camera pickup characteristics, operation of charged coupled imaging device, generation of primary colours, principles of additive colour mixing, chrominance and luminance signals, frequency interleaving technique, modulation of colour difference signals, colour burst, different standards for colour TV system, colour encoder, monochrome and colour television transmission (6)

Digital Video recording and playback: optical recording and playback, Compact Disk technology. (4)

Receiver Circuits and Components: RF tuner and AGC circuits, keyed AGC, IF amplifier and trap circuits, video detector and amplifier, colour decoder, horizontal and vertical deflection circuits, remote control, picture tube (5)

Audio and Video compression: Digitization of video signals, different digital formats, 4:2:2, 4:2:0, SIF, CIF, QCIF, video compression principle, JPEG, MPEG, MPEG-2, MPEG-4, video coder and decoder, video compression principle, frequency masking, temporal masking, MPEG layer I, layer II and layer III format, compatibility issues of different formats, elementary streams, syntax, MPEG transport stream (TS), integrated receiver decoder structure (IRD) (5)

Broadcast transmission and network: principle of OFDM, Transmission channels and bands, terrestrial transmission network, cable TV network, broadband and interactive services/video on demand (VOD)/high speed internet access, satellite TV network .(4)

Advanced Television: HDTV system standard, FFT based multicarrier system and transmitters.

RP2.2.7 - DIGITAL COMMUNICATION EXPERIMENTS (0 0 3)

1. Design, implementation and studies of the properties of p-n sequence using shift register

2. Studies of PCM transmitter and receiver
3. Design and studies of i) delta modulator and demodulator ii) OOK modulator and demodulator iii) PSK modulator and demodulator iv) FSK modulator and demodulator v) PRK modulator and demodulator
4. Design of a cyclic code generator and demodulator
5. Studies of TDM system (multiplexer and demultiplexer)
6. Studies of spread spectrum modulation and demodulation

RP2.2.8 - MICROWAVE CIRCUITS EXPERIMENTS (0 0 3)

Impedance Measurement
Q-Measurement
Measurements on Microwave Sources
Measurements on Microwave Components
Transmission and reflection characteristics of transmission lines

RP2.2.9 - Instrumentation and Control (3 0 0)

Fundamentals of instrumentation: resolution, accuracy, precision encoding, decoding, multiplexing etc, analog and digital instruments: a comparative study and review. [1]
A/D and D/A converters: sample and hold circuit, measurements of low, medium and high frequency signals, timing and programmable timers, digital voltmeters and signal chip multimeter, analog and digital data acquisition systems, high stability function generator and application of D/A converters, linearisation of electrical signals. [7]
Microprocessor based instrument: advantages of using microprocessor in instrument, A/D, D/A, S/H circuits with the microprocessor, measurement of phase, frequency, power, energy etc, errors encountered, different types of errors, reduction of gross, systematic, random errors and internal noise of instruments, data acquisition, linearisation, function, generation, recording, and production of analog signals. [8]
Data communication for instruments: smart instruments, IEEE488 parallel bus, RS232 serial line, USARTS, MODEMS, long distance data communication. [4]
Transducers: piezoelectric, capacitive, LVDT. [3]
Fundamentals of control engineering: on-off, proportional, integral, derivative and PID controls, microprocessor based control systems, diagnostic tool and softwares, distributed digital control. [7]

RP 2.2.10 – Computer Graphics (3 0 0)

Graphics Primitives: Typical graphics resolution, Graphical User Interface, Coordinate system, Aspect ratio correction, Image processing - picture analysis, Interactive graphics, Development of hardware and software, Display device, Raster refresh graphic display, Frame buffer and look up tables, Video controller. [7]
Basic Transformations: Homogeneous coordinates, World coordinates, Normalized device coordinates, Transformation matrices, Transformation in 2-D; Translation, rotation, scaling, shearing, reflection. 3D transformations. [5]
Points and Lines: Line drawing algorithm, Circle generating algorithm, Ellipse generating algorithm, Character generation, Half toning, Anti-aliasing. [4]

Curves and Surfaces: Spline representations, Bezier curves, B-spline curves, Drawing curves using forward differences, Quadratic surfaces. [4]
Window and Clipping: Window, Viewport, Zooming, Panning, Clipping, Transformation in 3-D, Projection-perspective and parallel projections, Computing vanishing points.[4]
Three Dimensional Viewing and Representation: Hidden surface removal, Back face removal, Z-buffer algorithm, Painter's Algorithm, Shading, Gouraud and Phog shading, Fractals, Self-similar fractals, Animations. [6]

RP2.2.11 - IMAGE PROCESSING AND COMPUTER VISION (3 0 0)

Representation of multi-dimensional signals, neighborhood operators, imaging algorithm, morphological operators, fuzzy image processing, neural net computing. [15]

Vision system, radiometry of imaging, solid state image sensing, geometric calibration of digital imaging systems, two and three dimensional imaging techniques. [15]

RP2.2.12 - FORMAL LANGUAGE AND AUTOMATA THEORY (3 0 0)

Fundamentals : Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and nondeterministic finite automaton, transition diagrams and Language recognizers.
Finite Automata : NFA with Î transitions Significance, acceptance of languages. Conversions and Equivalence : Equivalence between NFA with and without Î transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output - Moore and Melay machines.
Regular Languages : Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets.
Grammar Formalism : Regular grammarsright linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms.Right most and leftmost derivation of strings.
Context Free Grammars : Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).
Push Down Automata : Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. Introduction to DCFL and DPDA.
Turing Machine : Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines.
Computability Theory : Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar, decidability of, problems, Universal Turing Machine, undecidability of posts. Correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problems.

RP 3.1.1 - MATERIALS SCIENCE AND TECHNOLOGY (3 0 0)

Structures of Solids: Atoms and their binding, Bonds, Crystal Structures, Unit Cells, Latticed irections and planes (Miller Indices), Materials: Crystalline, Polycrystalline and Amorphous Materials. [2]

Crystalline Solids and Defects: Metals, Semiconductors and Insulators, Defects in crystals: point defect, Line defect, Planar defect. [2]

Concepts of Growth Techniques: Principles of Czochralski method, Zone melting, CVD, LPE, VPE, MBE, MOCVD, Diffusion of impurities: thermal diffusion, Implantatiion [2]

Dielectrics: Polarizabilities, Dielectric Loss, Ferroelectricity, Piezoelectricity, Accousto-electric interactions, Non-linear optical properties [2]

Superconductors: Characteristic Properties, Meissner Effect, BCS gap, High-T superconductors, Hard and Soft Materials, SQUID [3]

Magnetic Properties of Materials: Different types of magnetism, Diamagnetism, Paramagnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetism, Magnetic Domains [2]

Optical Properties: Absorption, Emission, Luminescence, Electro-optic and acousto-optic effects, Photorefractive effects, non-linear optics [3]

Materials for Electronic Components: Discrete Resistors, Capacitors, Inductors, Transformer and other magnetic devices, Hybrid and Monolithic ICs and components [3]

Materials for Data Storage: Magenetic Storage - Magnetic Cores, Tapes, Disks, Hard disk, Floppy disk, Magneto-optic devices, Bubble Memories, Magnetoelectronic materials, Giant Magneto-Resistance, Spin valves, Optical Storage - CD, DVD, Electrical Storage - CCD. [4]

Materials for Display Devices: Cathode Ray Tube, LED, LCD, TFT Display, Plasma Display [3]

Materials for Optical Communication: LED and Laser materials, Optical Fiber [2]

Materials in Other Applications: Photocopy, Printing, Medical applications, etc. [2]

RP3.1.2 - VLSI DESIGN (3 0 0)

Overview: Issues in IC design-size and complexity, different technological route-full-custom, semi-custom/ASIC, PLD's; Quality Metrics-cost, functionality & robustness, performance, energy consumption. (2)

Manufacturing process: The silicon wafer-crystal growth, wafer preparation, epitaxy; Oxidation and doping, Photolithography, Some recurring process steps, Simplified process flow for MOS & Bipolar technology. (3)

The design process: Layout techniques; schematic, stick diagram, physical design; Scaling; Spice models-circuit parameters/parameter extraction, Design Rules and DRC. (3)

Design of digital circuits: Review of CMOS design techniques, The CMOS inverter and basic gates, Comparison with other logic families, Static vs Dynamic logic, Delay calculation, Logical Effort, Driving large capacitive loads. (7)

Low power design of CMOS circuits: Power dissipation in CMOS digital circuits, static and dynamic power, various components of leakage currents in MOSFETs, different techniques of leakage power control. (6)
The wiring Network: Elmore delay calculation, Lumped and distributed RC lines; Delay in long lines-buffers and buffer placement. (2)
Sequential circuits: Latches and Flip-flops, Timing metrices for sequential circuits, clock circuits and clock distribution networks. (3)
Design Automation: Custom vs semi-custom- Circuit partitioning, Placement and Routing/ Floorplanning; Algorithms for physical design. (6)

RP3.1.3 - MOBILE AND SATELLITE COMMUNICATIONS (3 0 0)

Terrestrial Cellular Telephony: Cellular concept, cell cluster, Frequency reuse, Mobile Station (MS), Base Station (BS) , Mobile Switch Centre (MSC), Different cellular standards , Digital cellular systems, TDMA, Global system for mobile communications (GSM), GSM network, CDMA-based cellular network. [8]
Data Operations for Mobile systems: IP based mobile system, General packet Radio Service (GPRS), EDGE Technology. [3]
Wireless Networks: Ad Hoc Network, WLAN, WMAN; Mobile Satellite Network. [4]
Satellite Orbital Characteristics: Classification of satellites on the basis of orbital geometry, Location of a satellite in space, Perturbations on a satellite in orbit, Launching mechanism of geostationary satellites, Orbital effects on the satellite-earth station communication link [4]
Satellite Subsystems and Satellite Link Design: AOCS, TT&C, Power System, Communication Subsystems, Spacecraft Antennas, Transponders, Reliability of space qualified equipment, Friis transmission equation, G/T ratio of earth stations [7]
Propagation Effects affecting satellite-earth station links: Tropospheric and Ionospheric effects [2]
Spread Spectrum systems and GPS: Basics of TDMA, FDMA, CDMA, GPS, Application of GPS in Satellite Based Augmentation System [3]

RP3.1.4 - DIGITAL INSTRUMENTATION AND MEASUREMENTS (3 0 0)

Introduction: Fundamentals; resolution ,precision and accuracy. Advantages of digital instruments and instrumentation: Significant digits, encoding, programming , voltage and time standards etc, rigorous recapitulation of some fundamental hardwares.
Hardware oriented topics: A/D, D/A converters; Sample and hold circuits, measurement of low, mediumand high frequencies. Time period, pulse width, phase difference.and power factor measurements.
Generation of time bases for measurements. Programmable digital timer, single chip digital voltmeters, and multimeters. Concept of auto zero, linearisation of electrical signals,analog versus digital. Data acquisition and function generation, applications of D/A converters.
Microprocessor / computer oriented topics: When to use the microprocessor in instruments. Advantages of using the Microprocessor in instruments. A/D,D/A, and S/H circuits with microprocessors. Measurement of phase, frequency, power factor, time period , power, energy.
Errors encountered in different types of measurements.

Reduction of gross, systematic and random errors., and internal noise of an instrument to enhance metrological performance.
Data acquisition, function generation , linearization.
Stepper motor control. Digital recording and reproduction of voice signals. Basics of Data compression.
Data communication for instruments: Advantages of smart instruments, IEEE 488 Parallel Bus, RS232 Serial line , USART, MODEM. Introduction to long distance data communication.
Diagonostic tools and softwares: Logic state analyzer, signature analyzer, softwares for the testing of RAM ,ROM, Terminals etc.
Transducers for digital systems: Linear Variable Differential Transformer (LVDT), Capacitive and Piezoelectric transducers.
Measurements on Semiconductors: Fundamental measurements like Photoluminescence, Hall etc.

RP3.1.5 - RADAR AND NAVIGATIONAL ELECTRONICS (3 0 0)

Radar: Basic principles of Radar; Range equation; Factors influencing the range performance. (3)
Targets and their Properties: Basic concept of Radar Cross-Section (RCS); Complex targets; Target fluctuations. (2)
Pulse and CW Radar: Pulse vs. CW Radar systems; FM-CW Radar; Radio Altimeter.(3)
MTI and Pulse Doppler Radar: Moving Target Indication principles; Blind speed; Practical MTI principles; Signal processing in MTI radar Tracking Radar : Continuous tracking and track while scan (TWS); Sequential lobing and conical scan principle; Monopulse technique of target tracking. (2)
Antennas and Beam Steering: Radar antennas; Phased Array antenna; Phase shifters.(4)
Radar Transmitters and Receivers: Radar transmitter consideration; Duplexers and receiver protectors; Receiver front end; Mixers; Effect of noise on receiver performance. (3)
Special Radars: OTH Radar; Synthetic Aperture Radar; Bistatic Radar; Electronic Counter-Counter Measures. (3)
Air Navigation: Meteorological Radar; Radiosonde; Radiometeorological and visibility Sensors; Raingauge measurements for forecasting. (3)
Instrument Landing System: VHF and Microwave ILS. (3)
Loop Direction Finder: Direction and sense finders; Automatic Direction Finder with Radio Compass. (2)
Hyperbolic Navigation: LORAN - A, DECCA, OMEGA, DECTRA, DERLAC, HIFIX. (2)
Satellite Navigation and Remote Sensing: Global Positioning System (GPS); Doppler Satellite Navigation; Satellite Imaging. (5)

RP3.1.6 - MICROWAVE ANTENNAS (3 0 0)

Review of Antenna Terminologies and Characteristics of Dipole Radiators. (3)

Classification of Microwave Antennas with brief descriptions of their functions. (2)

Radiation from Rectangular and Circular Apertures: Diffraction Theory (3)

Reflector Antennas: Corner Reflectors; Spherical Reflectors; Parabolic Reflectors - Prime-focus and Cassegrain systems. Offset configurations. Applications in Satellite Communication and Radiometers. (8)

Horn Antennas: Types and Principles; Applications as Feeds for Reflectors; Low Noise Feeds; Broadband and Multi-band Feed. (5)

Planar Antennas: Review of Microstrip basics; Microstrip Patch Antennas – Radiation mechanism, Configurations; Printed Dipole. Conformal Antenna. (5)

Slot Antennas: Radiation from slots in waveguide walls; Arrays (2)

Elements of Ultra Wide Band (UWB) antennas. (2)

RP3.1.7 - DATA STRUCTURES AND ALGORITHMS (3 0 0)

Introduction and Overview: Notion of Data, Data Type, Operation on Data, Representation of Data in Computer Memory, Fundamental Data Type, Aggregate Data Type, Variables, Abstract Data Type, Data Structure, Notion of Algorithm, Efficiency of Algorithm, Algorithmic Notation, Control Structures, [6]

Arrays and Pointers: Definition, Linear Array, Implementation of Linear Array, Operations on Linear Array, Application of Linear Array, Multidimensional Array, Implementation of Multidimensional Array, Pointer, Cursors, [6]

Linked List: Definition, Advantages Over Array, Implementation of Linked List in Computer Memory, Linked List as an Abstract Data Type, Operations on Linked List, Application of Linked List, Memory Allocation, Garbage Collection, Doubly Linked List, Circular Linked List, [8]

Stack: Definition, Implementation of Stack in Computer Memory, Stack as an Abstract Data Type, Operations on Stack, Application of Stack, Arithmetic Expression Evaluation, Recursion, Implementation of Recursion using Stack, [8]

Queues: Definition, Implementation of Queuein Computer Memory, Queue as an Abstract Data Type, Operations on Queue, Application of Queue, Deque, Priority Queue, [8]

RP3.1.8 - HETEROSTRUCTURE DEVICES (3 0 0)

Band Structure Modifications

Alloy band structure; Heterojunction: definition, band line-up and band offsets; Double Heterostructures.

Heterojunction Diodes

Capacitance; Injection efficiency [2]

Heterojunction Bipolar Transistors :

Structures; Mechanism of amplification; Evaluation of terminal currents from continuity equation and charge control model; Graded base transistors; Secondary effects; Transistor modeling. [5]

Optical Phenomena :

Band to band absorption and recombination; Stimulated emission; Population inversion; Condition for laser action. [3]

Light Emitting Diodes

Principle; Structures; Advantages of heterojunctions; Power-current curve; Modulation characteristics. [3]

Semiconductor Lasers :

Principle, structures; Advantages of heterojunctions; Single mode operation; Applications. [3]

Optical Amplifiers

Doped Fiber Amplifiers; Semiconductor Optical Amplifiers; Structures; Materials. Important characteristics. [2]

Photodetectors

Principle; Different types: pin, APD, MSM, photoconductors; Responsivity, Quantum Efficiency; Structures and Materials. [3]

Quantum Nanostructures

Method of formation; Energy quantisation in potential wells; Quantum Wells, Wires, Dots; Superlattices; Density-of-states functions; Carrier density; Energy levels and envelope functions. Some electronic and optical properties of low dimensional electron gas. [5]

Quantum Nanostructured Devices:

High Electron Mobility Transistors; Resonant Tunneling Diodes; Quantum Well, Wire and Dot Lasers; QWIP and QDIP. [4]

RP3.1.9 - VLSI DESIGN METHODOLOGY (0 0 3)

Detailed FPGA Architecture,Basic building Blocks of FPGA, Configurable Logic Block (CLB), Based on LUT, Interconnection Switch, Based on Switch Matrix, Multilevel Synthesis technique of FPGA, Factoring, Functional Decomposition

FPGA based implementation of basic Logic gates, Boolean functions, Code converters and their verifications.

FPGA based implementation of Combinational Logic circuits – MUX, DEMUX, Decoder, Serial & Parallel binary adder, BCD adder using 7 segment display and their verifications.

FPGA based implementation of Sequential Logic Circuits and Systems – Basic Flip-flops, Ring counters, Up-Down Ripple Counters, Decade Counter using on-board crystal clock and seven-segment display and their verifications.

FPGA based implementation of binary number Multiplier/Divider Circuits and their verifications.

RP3.1.10 - OPTICAL COMMUNICATION EXPERIMENTS (0 0 3)

Experiments on LED. Laser
Optical Fiber: Numerical aperture, attenuation measurements
Photodetector: Saturation, Eye-diagram
Expts. With optical voice link module.

RP3.1.11 - INSTRUMENTATION AND MEASUREMENTS (0 0 3)

1. Realization of Data Acquisition system
2. Pressure & Displacement measurement by Linear Variable Displacement Transducer (LVDT).
3. Study of load cell. (To study the load cell behavior for tensile & compressive load).
4. Relative Humidity measurement using Capacitive Transducer.
5. Measurement of angular speed by Stroboscope.
6. Determination of PI, PD, PID controller action on 1^{st} order simulated process.
7. Study of a typical Temperature Control Loop having Furnace, suitable final control element, SMART/Analog temperature transmitter (hand held communicator for SMART Transmitter), PID controller, and data logger etc.
8. Study of a typical Pressure Control Loop having Pressure source, Pneumatic control valve, I to P Converter, Compressor, SMART/Analog pressure transmitter, and PID controller etc.
9. PLC Programming through PC
10. Study of a PC based Simulation Software i.e. simulation of boiler of a power plant etc.
11. Study of flow/temperature control loop with DCS.

RP3.1.12 - FOUNDATION OF PROJECT WORK (0 0 3)

RP3.1.13 – ELECTRONIC DESIGN AND SIMULATION (0 0 3)

RP3.1.14 - JAVA PROGRAMMING (2 0 3)

Basics of Object Modeling: Object Modeling Techniques; Object Classes; Association; Behaviour description.

Fundamentals: Bytecode and Java Virtual Machines; Applications and Applets; Classes and Objects; Three Principles of Object Oriented Programming; Variables and Assignments; Strings and Characters; Arithmetic Operators and Assignments; Arrays.

Classes and Methods: Structure of a Method; Static and Instance Methods and Variables; Different Classes; Arrays of Objects.

Control Statements: If Statement; if-else Statement; for Statement; Increment and Decrement Operators; Relational and Boolean logical operators; while Loop; do Loop; break Statement; continue Statement; switch Statement.

Creating Classes: General form of a Class; Creating simple Classes; Adding Constructors, Constructor Overloading; Local Variables; Method Overloading.

Inheritance: Subclass; Inheritance and Variables; Method Overriding; Inheritance and Method. Modifiers; Object and Class Classes.

Interfaces and Packages: Interface References; Interface Inheritance; instance of Operator; Packages; import Statement.

Exception: Exception handling; throw Statement; Exception and Error Classes.
Multithread Programming: An Overview of Threads; Creating Threads; Synchronisation; Deadlock.

Java Class Libraries: The Random Class; The Date Class; The Calendar Class; The Vector Class and Enumeration Interface; Stack Class and Hashtable Class,
Input and Output: Files and Directories; Character Streams; Buffered Character Streams; Printwriter Class; Byte Streams; Random Access Files.

Applets: Overview of Applets; Life Cycle of an Applet; Graphics Class; Using Colours; Using Applet Dimensions; Using Applet in a Web Page; Applet Class; Using Images; Using Threads.

Introduction to Event Handling: Delegation Event Model; Event Classes; Event Listeners; Adapter Classes; Inner Classes.

AWT: Labels; Buttons; Canvases; Checkboxes; Choices; Text fields and Text areas; Scroll Bars; Layout Managers; Panels; Windows and Frames; Menu and Menu Bars.

RP 3.1.15 – Pattern Recognition (3 0 0)

Introduction to pattern recognition. [2]

Pattern recognition system: pattern classification, preprocessing, segmentation, feature extraction, post processing, feature space, classifier, learning and adaptation, supervised and unsupervised learning. [4]

Statistical approach to pattern classification: Bayesian decision theory, priori probability, posteriori probability, likelihood ratio, continuous features, two category classification, minimum error rate classification, normal density, univariate density, multivariate density, Baye's decision for discrete features, missing and noisy features. [8]

Maximum likelihood estimation: expectation maximization EM, maximum likelihood estimation, parametric and nonparametric estimation, Hidden Markov Model (HMM)[6]

Non parametric decision making: K-nearest neighbor classification technique, Parzon window estimator, adaptive decision boundary, Fuzzy classification. [6]

Unsupervised learning and clustering technique for classification: hierarchical clustering, single linkage algorithm, complete linkage algorithm, partial clustering, K-means algorithm. [6]

RP3.1.16 - PARALLEL AND DISTRIBUTED COMPUTING (3 0 0)

Introduction to parallel processing: parallel architecture, systolic and associative array, SISD, MIMD etc, data flow architecture, subsystems bandwidths, interprocessor communication, shared RAM, interconnection network. [8]

Systolic array: cross-bar and ring network, multi-stage network, dynamic communication. [4]

Parallel algorithms: sorting FFT, matrix operation, graph algorithm. [4]

Introduction to distributed computing: distribution of data and control, synchronization, distributed termination problem, load distribution, deadlocks in distributed systems.[5]

High level language support in distributed computing: message passing primitives, atomic action, remote procedure call mechanisms, case study of some languages like OCCAMII, LINDA. [5]

Formal development and verification of distributed algorithms. [6]

RP3.1.17 - DATA MINING (3 0 0)

Data warehousing: introduction, definitions, multi-dimensional data model, OLAP and OLAP engine. [5]

Data mining: introduction, definitions, KDD vs. DM, DBMS vs. DM, DM techniques, issues and challenges, application areas. [5]

Association rules: introduction, methods to discover association rules, algorithms. [5]

Clustering techniques: clustering paradigms, partitioning algorithms, k-medoid algorithms, hierarchical clustering. [5]

Decision trees: tree construction principle, decision tree construction algorithm, presorting. [5]

Web mining: content, structure and usage mining, text mining, image and multimedia mining [5]

Cryptoogy and information: classical cryptosystem, symmetric cryptology, public key crypto-system, elliptic curve crypto system, digital signature, quantum crypto-systems. [5]

RP3.1.18 - ADVANCED COMMUNICATION SYSTEMS (3 0 0)

Introduction: Communication systems: analog and digital; Signal to noise ration, bandwidth, information rate, randomness, coding.

Signals: Review of Fourier series, transform, coding, convolution, energy and power spectra and spectral densities.

Review of Modulation Formats: AM, FM, PM; Sampling theorem; PCM and Differential PCM.

Digital Data Transmission: Line coding, pulse shaping; scrambling; Regenerative repeater; Detection – error probability; M-ary communication; Digital multiplexing.

Probabilty and Random Variables: Probability theory; Conditional probability; Discrete and continuous random variables; Statistical averages; Probability models: binomial, Poisson, Gaussian, Rayleigh.

Random Signals and Noise: Random processes; Ensemble average and correlation functions; Random signals: power spectrum; Noise; Baseband signal transmission with noise; Baseband pulse transmission with noise.

Channel Coding and Encryption: Error detection and correction: repetition and parity check codes, interleaving, Hamming distance, FEC and ARQ systems. Linear block codes- cyclic and M-ary codes; Convolution codes; Data encryption.

Spread Spectrum Systems: Direct Sequence Spread Spectrum; Frequency Hop Spread Spectrum; Coding; Synchronization; Application in cellular telephone and personal communication systems.

Information and Detection Theory: Information measure; Entropy; Coding for discrete memoryless and with memory channels; Information transmission on discrete channels; Continuous channels and system comparisons; Signal space; Optimum digital detection.

RP3.1.19 - MOBILE COMPUTING (3 0 0)

Wireless networks, wireless carriers, location-based technologies, wireless platform operating systems and micro-browsers, wireless marketing, wireless security issues, Wireless Application Protocol (WAP), Wireless Markup Language (WML), Java 2 Micro Edition (J2ME), and mobile CRM.

RP3.1.20 - Artificial Intelligence and Robotics (3 0 0)

Introduction: Principles of AI; Classification; Heuristics; Programming methods; Modeling. [3]

Tools and Techniques: Programming environments; POPLOG; LISP. (2) Applications : Computer processing of natural language; Speech synthesis and recognition; Computer vision; AI and robotics; Anatomy of expert systems. [10]

Frontiers : Machine learning; Memory models of man and machine. [6]

Bayesian Estimation, Maximum Likelihood Estimation, Kalman filtering, Multiple Hypothesis Tracking, Particle Filtering, Laser Scan Matching, Image-based Motion Estimation, Gyroscope Noise Modeling, Odometry Propagation

Localization, Representations (Mapping), Simultaneous Localization and Mapping (SLAM), Multi-robot Localization & SLAM [15]

RP3.2.1 - ECONOMICS AND MANAGEMENT (3 0 0)

Nature and Functions of the Economic System: Basic questions of Economics - The Economic System-Unit of Economic Analysis- How the economic system works - Possible alternatives of the organisational forms. Market Morphology: Different market forms and their mechanism. Demand Analysis: Demand theory-Methods of forecasting demand-Price relations-Income relations-Multiple relations. Cost Analysis: Concepts of cost under different purposes-cost and rate of output-cost and size of the plant-cost and profit forecasting-short run and long run

production function-firm's optimal decision relating to input combinations-expansion path of a firm- return to scale-short run and long run cost of production-average and marginal cost-supply curve for the firm and the industry. Pricing: Price determination under different types of market-Cost plus pricing-cyclical pricing and other pricing mechanism including price differentials. Capital Budgeting: Demand for capital-supply of capital-capital rationing-classification of capital expenditure-capital budgeting. The Circular Flow of Income: The model of circular flow of income-equilibrium in the circular flow income-household consumption-investment and saving-fluctuations in the levels of economic activity-theory of employment. Money, Banking and the Price Level: The concept of money-functions of money-system of issue of paper money-role and functions of commercial and central banks-Credit money-demand for money-institutions of money market-determination of price level-value of money-inflation, deflation and stagflation. National Income and National Product: Concept of national income and national product-measurement of national income difficulties and limitations-index number. Government and Economic System: Role of Government-Sources of Government revenue-deficit financing and its effects-Government regulation and business concentration-multinational firm and its regulations. (20)

INDUSTRIAL MANAGEMENT: Introduction to Business Management and Industrial Organization: Concept, characteristics and classification of business activities. Types of business organizations: Features. Basic Management and Entrepreneurial Decisions and Considerations in Establishing Business Enterprises. Plant Location: Plant layout, factory buildings. Administrative Management: Concept, functions of management. Materials Management: Industrial purchasing, storekeeping, materials handling, inventory management and control Production Planning and Production Control. Scientific Management: Elements, contemporary thoughts in management. Financial Management: Capital and capitalization, estimation of total capital requirement of a business – sources of finance, Personnel Management: Wages, incentives, industrial discipline. Role of Computers in Management: Computers and management functions, computer based financial system, inventory system, computer in human resources management. (15)

RP3.2.2 - HIGH FREQUENCY AND OPTOELECTRONIC DEVICES (3 1 0)

High Frequency Devices:

Varactor diode, p-i-n diode, tunnel diode, Schottky diode- principles, structures, high frequency characteristics and applications

IMPATT diode, SDR, Read Diode, TRAPATT diode, Barritt diode – Structures, principles, applications

Gunn diodes: principles of operation, modes of operation, structure and applications

Transistors: BJTs and FETs - High frequency figures of merit, material and design requirements.

HBTs and HEMTs – Structures, principles, Performance characteristics, Equivalent circuits, applications.

Optoelectronic Devices:

Absorption and recombination mechanisms in Semiconductors, Non-equilibrium Condition: Excess Carriers

LED: Principle, Structure, Materials, Performance characteristics (L-I curve, efficiency, modulation, …), applications

Semicondictor Laser: Principle, Structure, Performance characteristics (Threshold current, Power output, bandwidth, modes, …), applications
Semiconductor Optical Amplifiers: Principle, Structure, Performance characteristics
Photodetectors: Types, PDs with and without gain: Structures, Principles, Performance characteristics (Quantum efficiency/Responsivity bandwidth, Gain, …), applications

RP3.2.3 - OPTICAL COMMUNICATION AND NETWORKING (3 0 0)

Basic communication system: Principles, components; Difference between optical and other forms of communication; Block diagram of point-to-point link. [1]
Review of Properties of Optical Fibre: Structure; Light guidance; Single and multimode operation; Attenuation; Dispersion; Wavelengths for data and long-haul communication; Simple idea for bit rate-length products. [2]
Sources for optical communication: LEDs: principle, materials, structures, linewidth, coupling to fibres; Laser diodes: principle, double heterostructure, gain and index guiding, distributed feedback lasers, Quantum Well lasers; Modes and narrow linewidth lasers; Modulation; Bandwidth for modulation; Optical transmitters: components. [2]
Detectors and photoreceivers for optical communication: Principle; Types; Efficiency, responsivity, bandwidth; Preamplifiers; Noise sources; Signal-to-noise Ratio (SNR).[2]
Point-to-point Link: Building blocks; Multiplexing; Intensity Modulation /Direct Detection system; Principle of Regeneration; Impairments; Bit Error Rate calculation; Gaussian probability distribution function for noise. Illustrative calculations. [5]
Analog communication: Analog subcarrier multiplexing; Coherent systems and SNR; Applications of SCM: Cable TV. [2]
Wavelength Division Multiplexing: Principle and advantages; TDM vs. WDM; Optical amplifiers: Er doped, Raman and Semiconductor Optical amplifiers; Tunable lasers; Tunable Fabry-Perot filters; Other detection schemes; Dispersion compensation and management; Wavelength assignment. [5]
Guided wave optics: Dielectric waveguides; Coupling; Directional couplers; Applications in WDM; Guided wave control: electro-optic and magneto-optic effects; Applications in modulators and other components; Bragg gratings: structure, principle and applications. [5]
Link analysis: Power budget; rise time budget. [1]
Optical Networks: LAN, MAN, WAN; Topologies: bus, star, ring; Ethernet; FDDI; Telecomm networking: SDH/SONET. [4]
Different forms of access Networks: Telephony; ISDN; Cable TV; Broadcast and Switched networks; HFC networks; FTTC and FTTH networks; All optical networks. [4]

RP3.2.4 - GENERAL VIVA-VOCE (0 0 0)

RP3.2.5 - PROJECT WORK (0 0 9)

RP3.2.6 - SOFTWARE ENGINEERING (3 0 0)

Introduction to Software Engineering: Software development and life cycles, software requirements and analysis, Cost estimation and evaluation techniques. [5]

Software Design: Design concepts - Architecture design, Detailed design, Abstractions - Data, Control, Functional, Information hiding principle, Modular design - Coupling, Cohesion, Verification and verification methods, Structured system design, Data oriented analysis and design, Object oriented analysis and design. [10]

Software Quality Assurance: Software testing techniques and strategies, software repair and maintenance, Computer aided software engineering, Software complexity and reliability. [10]

Software Project Management: Case studies. [10]