JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
Kukatpally, Hyderabad – 500 085

ACADEMIC REGULATIONS 2021(R-21)

Under choice based credit system (CBCS)

M.Sc (Regular/Full Time) Program

(Effective for the students admitted into the I year from the Academic Year 2021-22 and onwards)

1.0 Post-Graduate Degree Program in M.Sc. (PGP in M.Sc.):

JNTUH offers a 2 Year (4 Semesters) full-time Master **of Science** (M.Sc.) Degree Programs, under Choice Based Credit System (CBCS) at its Constituent Autonomous College - JNTUH College of Engineering Hyderabad with effect from the Academic Year 2021-22 onwards.

2.0 Eligibility for Admission:

2.1 Admissions to the PGPs shall be made subject to the eligibility, qualifications, and specializations prescribed by JNTUH College of Engineering Hyderabad, J NT University Hyderabad, for each Specialization under each M.Sc. The program, from time to time.

2.2 Admission to the PGP shall be made based on the 'common postgraduate entrance test' (CPGET), a state-level entrance test conducted by Telangana state council for higher education or Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad or based on any other order of merit approved by the University, subject to reservations as prescribed by the Government from time to time.

2.3 The medium of instructions for all PGP s in M.Sc will be in ENGLISH only.

3.0 M.Sc. Program Structure:

3.1 The M.Sc. Program in Mathematics, Physics, and Chemistry of JNTUH-CEH are of Semester Pattern, with 4 Semesters constituting 2 Academic Years. Each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC / AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these PGPs in M.Sc - Academic Regulations.

3.2.1 **Semester Scheme:**
Each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester

System (CBSS) as denoted are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab Course', or 'Design/ Drawing Subject', or 'Seminar', or 'Comprehensive Viva', or 'Project', as the case may be.

3.2.2 **Credit Courses:**

All Subjects (or Courses) are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a Lecture Periods: Tutorial Periods: Practicals Periods: Credits(an L: T: P: C) Structure, based on the following general pattern.

3.2.3 **Course Nomenclature:**

The curriculum nomenclature or Course structure grouping for M.Sc Degree Program is as listed below

Each subject is assigned a certain number of credits as specified below.

Theory Subjects	4 Periods / Week	3 / 4 Credits
Practical subjects	6 Periods / Week	2 Credits
Seminar	2 Periods / Week	1 Credit
Seminar	4 Periods / Week	2 Credit
Project		3 or 4 Credits

4.0 Course Work:

4.1 A Student, after securing admission, shall pursue and complete the M.Sc PGP in a minimum period of 2 Academic Years (4 Semesters), and within a maximum period of 4 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall Register for and Secure the specified number of credits required for the completion of the PGP and Award of the M.Sc Degree in the respective Branch with the chosen Specialization.

4.3 I and II years are structured to provide typically 22 Credits (22 C) in each of the I, II III Semesters, and the IV Semester comprises 24 Credits (24 C), totaling 90 Credits (90 C) for the entire M.Sc Program.

5.0 Course Registration:

5.1 A 'Faculty Advisor' shall be assigned to each M.Sc Program with respective Specialization, who will advise the Students about the M.Sc Program Specialization, its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on his competence, progress, pre-requisites, and interest.

6.0 Attendance Requirements:

6.1 A Student shall be eligible to appear for the Semester End Examination (SEE) of any Subject if he acquires a minimum of 75% of attendance in that Subject for that Semester.

6.2 A Student's Seminar Report and Seminar Presentation shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar Presentation Classes during that Semester.

6.3 Condoning of shortage of attendance up to 10% (65% and above, and below 75%) in each Subject or Seminar of a Semester may be granted by the College Academic Council on genuine and valid grounds, based on the Student's representation with supporting evidence.

6.4 A stipulated fee per Subject/Seminar shall be payable towards condoning of shortage of attendance.

6.5 Shortage of Attendance below 65% in any Subject/Seminar shall in NO case be condoned.

6.6 A Student, whose shortage of attendance is not condoned in any Subject(s) or Seminar in any Semester, is considered as 'Detained in that Subject(s)/ Seminar', and is not eligible to take End Examination(s) of such Subject(s) (and in case of Seminars, his/her Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he has to seek Re-registration for those Subject(s)/Seminar in subsequent Semesters, and attend the same as and when offered.

7.0 Academic Requirements:

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in Item No. 6**.**

7.1 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if (i) he/she secures not less than 40% Marks (28 out of 70 Marks) in the Semester end Examination, and (ii) a minimum 50% of the sum of the marks in CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) both taken together; in terms of Letter Grades, this implies securing B Grade or above in that Subject.

7.2 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Seminar, and Comprehensive Viva-voce, if he/she secures not less than 50% of the total Marks to be awarded for each. The Student would be treated as failed, if he/she - (i) does not attend the Comprehensive Viva-voce as per the schedule given, or (ii) does not present the Seminar as required, or (ii) secures less than 50% of Marks (< 50 Marks) in -Seminar/ Comprehensive Viva-voce evaluations.
She/ he may reappear for comprehensive viva where it is scheduled again; For seminar, he has to reappear in the next subsequent Semesters, as and when scheduled.

7.3 A Student shall - register for all Subjects covering 90 Credits as specified and listed in the Course Structure for the chosen PGP Specialization, put up all the Attendance and Academic requirements for securing 90 Credits obtaining a minimum of B Grade or above in each Subject, and 'earn all 90 Credits securing SGPA $\geq$ 5.0 (in each Semester) and final CGPA (ie., CGPA at the end of PGP) $\geq$ 5.0, to successfully complete the PGP in M.Sc.

7.4 Marks and Letter Grades obtained in all those Subjects covering the above specified 90 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of IV semester in II Year r.

7.5 Students who fail to earn 90 Credits as per the specified Course Structure, and as indicated above, within 4 Academic Years from the Date of Commencement of their I Year, shall forfeit their seats in M.Sc Program and their admissions shall stand cancelled.

7.6 When a Student is detained due to shortage of attendance in any Subject(s)/Seminar in any Semester, no Grade Allotment will be done for such Subject(s)/Seminar, and SGPA/ CGPA calculations of that Semester will not include the performance evaluations of such Subject(s)/Seminar in which he/she got detained. However, he becomes eligible for re-registration of such Subject(s)/Seminar (in which he got detained) in the subsequent Semester(s), as and when next offered, with the Academic Regulations of the Batch into which he gets readmitted, by paying the stipulated fees per Subject. In all these re-registration cases, the Student shall have to secure a fresh set of Internal Marks (CIE) and End Semester Examination Marks (SEE) for performance evaluation in such Subject(s), and subsequent SGPA/ CGPA calculations.

7.7 A Student eligible to appear in the End Semester Examination in any Subject, but absent at it or failed (failing to secure B Grade or above), may reappear for that Subject at the supplementary examination as and when conducted. In such cases, his/her Internal Marks (CIE) assessed earlier for that Subject/ Course will be carried over, and added to the marks to be obtained in the supplementary examination, for evaluating his performance in that Subject.

8.0 Evaluation - Distribution and Weightage of Marks:

8.1 The performance of a Student in each Semester shall be evaluated Subject-wise (irrespective of Credits assigned) with a maximum of 100 Marks for Theory, Practical and 50 marks for Seminar.

8.2 a) For Theory Subjects, Continuous Internal Evaluation (CIE) Marks shall comprise of - Mid-Term Examination Marks (for 25 Marks), and Assignment Marks (for 5 Marks) for total of 30 marks.

b) During the Semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 25 Marks (with 120 minutes duration). The better performance out of these two Mid-Term Examinations shall be considered for the award of 25 Marks.

c) At least two assisgnments shall be given to the students befoe the conduct of each mid examination.Based on the performance of the student in submitting the assignments , he/she will be awarded marks evaluated for 5 marks.

8.3 For Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 Internal Marks, and 70 Marks are assigned for Lab./Practicals End Semester Examination (SEE). Out of the 30 Marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 Marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The SEE for Lab./ Practicals shall be conducted at the end of the Semester by the concerned Lab. Teacher and another faculty member of the same Department as assigned by the Head of the Department.

8.4 There shall be a Seminar Presentation in I Semester II Semester and III Semester. For the Seminar, the Student shall collect the information on a specialized topic, and submit to the Department which shall be evaluated by a Departmental committee consisting of the Head of the Department and two faculty members both appointed by HOD at the time of Seminar Presentation. The Seminar Presentation shall be evaluated for 50 Marks. There shall be no SEE or External Examination for Seminar.

8.5 a) Every PGP Student shall be required to execute his/her M.Sc Project, under the guidance of the Supervisor assigned to him/her by the Head of Department. The PGP Project shall start immediately after the completion of the II Year I Semester, and shall continue through II Year II Semester. The Student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 2 weeks (immediately after his II Year I Semester End Examinations), for approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of Department, and shall consist of the Head of Department, Project Supervisor, and a Senior Faculty Member of the Department both appointed by HOD. The Student shall submit his/ her Project Work Proposal to the PRC, on whose approval he can 'REGISTER for the PG Project'. Every Student must compulsorily register for his/her M.Sc Project Work, within the 2 weeks of time-frame as specified above. After Registration, the Student shall carry out his work, and continually submit 'a fortnightly progress report' to his/her Supervisor throughout the Project period. The PRC will monitor the progress of the Project Work Presentation and submission of M.Sc Project Work Report/ Dissertation.

b)The PRC shall evaluate the entire performance of the Student and declare the Project Report as 'Satisfactory' or 'Unsatisfactory'.There shall be no SEE or External Examination for Seminar.

8.6 a) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the Student is deemed to have failed in the Project Viva-voce Examination, and he/she has to reappear for the Viva-voce Examination as per the Board recommendations. If he/she fails in the second Viva-voce Examination also, he will not be considered eligible for the Award of the Degree, unless he/she is asked to revise and resubmit his/her Project Work by the Board within a specified time period.

9.0 Re-Admission / Re-Registration:

9.1 **Re-Admission for Discontinued Students:**
Students, who have discontinued the M.Sc Degree Program due to any reasons what so ever, may be considered for 'Readmission' into the same Degree Program (with same specialization) with the Academic Regulations of the Batch into which he/she gets readmitted, with prior permission from the concerned authorities, subject to Item 4.1.

9.2 Re-Registration for Detained Students:

When any student is detained in a Subject (s)/ Seminar due to shortage of attendance in any Semester, he/she may be permitted to re-register for the same Subject in the 'same category' (Core or Elective Group) or equivalent Subject if the same Subject is not available, as suggested by the Board of Studies of that Department, as when offered in the sub-sequent Semester(s), with the Academic Regulations of the Batch into which he/she seeks re-registration , with prior permission from the concerned authorities, subject to Item 4.1.

10.0 Grading Procedure:

10.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

10.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
80% and above (≥ 80% , ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (≥ 70% , < 80%)	A^+ (Excellent)	9
Below 70% but not less than 60% (≥ 60% , < 70%)	A (Very Good)	8
Below 60% but not less than 55% (≥ 55% , < 60%)	B^+ (Good)	7
Below 55% but not less than 50% (≥ 50% , < 55%)	B (Above Average)	6
Below 50 (< 50%)	F (fail)	0
Absent	**Ab**	**0**

10.3 A student obtaining an F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his/her Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

10.4 A Letter Grade does not imply any specific % of Marks.

10.5 A student earns Grade Point (GP) in each Subject/ Course, based on the Letter Grade obtained by him/her in that Subject/ Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

10.6 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = { $\sum_{i=1}^{N} C_i G_i$ } / { $\sum_{i=1}^{N} C_i$ } …. For each Semester,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the i^{th} Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

10.7 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in the overall Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year first semester onwards, at the end of each semester, as per the formula

CGPA = { $\sum_{j=1}^{M} C_j G_j$ } / { $\sum_{j=1}^{M} C_j$ } … for all S Semesters registered (ie., up to and inclusive of S Semesters, S ≥ 1),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1^{st} Semester onwards up to and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j^{th} Subject. After registration and completion of the I Year I Semester, however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

10.8 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

10.9 For Calculations listed in Item 10.5 – 10.8, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

10.10 **Passing Standards :**

10.10.1 A student shall be declared successful or 'passed' in a Semester, only when he/she gets an SGPA ≥ 5.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA ≥ 5.00; subject to the condition that he/ she secures a GP ≥ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP) for the Degree Award, as required.

10.10.2 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA, and CGPA.

11.0 Declaration of Results:

11.1 Computation of SGPA and CGPA are done using the procedure listed in 10.5 – 10.8.

11.2 For Final % of Marks equivalent to the computed CGPA, the following formula may be used ..

% of Marks = (CGPA – 0.5) x 10

12.0 Award of Degree and Class:

12.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **90** Credits (with GP $\geq$ 6.0), shall be declared to have 'QUALIFIED' for the award of the M.Sc Degree in the chosen specialization as he/ she admitted.

12.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Sc. Degree, he/she shall be placed in one of the following four classes based on the % CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75 ≤ CGPA < 7.75
Second Class	5.75 ≤ CGPA < 6.75
Pass Class	5.0 ≤ CGPA < 5.75

12.3 A student with a final CGPA (at the end of the PGP) < 5.00 will not be eligible for the award of Degree.

13.0 Withholding of Results:

13.1 If a student has not paid fees to University/ College at any stage, or has pending dues against his name due to any reason whatsoever, or if any case of indiscipline is pending against him/her, the result of the Student may be withheld, and he/she will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

14.0 Transitory Regulations:

14.1 A Student - who has discontinued for any reason, or who has been detained for want of attendance as specified, or who has failed after having undergone PGP, may be considered eligible for readmission to the same PGP with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and same Professional Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 4 years from the Date of Commencement of his/her I Year I Semester).

15.0 Student Transfers:

15.1 There shall be no Branch/ Specialization transfers after the completion of the Admission Process.

15.2 There shall be no transfer among the Constituent Colleges and Units of Jawaharlal Nehru Technological University Hyderabad.

16. MALPRACTICES RULES:

	Nature of Malpractices	Punishment
	If the candidate:	
1 (a)	Possesses or keeps accessible in the examination hall, any paper, notebook, programmable calculators, Cell phones, pager, palm computers, or any other form of the material concerned with or related to the subject of the examination (theory or practical) in which he/ she is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1 (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In the case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers, or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be canceled.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from the examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated shall be canceled in all the subjects of the examination (including practicals and project work) that already appeared and

		shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all examinations. The continuation of the course by the candidate is subject to academic regulations in connection with the forfeiture of seats. If the imposter is an outsider, he/she will be handed over to the police and a case is registered against him/her.
4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all examinations. The continuation of the course by the candidate is subject to academic regulations in connection with the forfeiture of seats.
5	Uses objectionable, abusive, or offensive language in the answer paper or letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walkout or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his/her person or any of his/her relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his/her relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In the case of outsiders, they will be handed over to the police, and a police case is registered against them.

	officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7	Leaves the exam hall taking away the answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all examinations. The continuation of the course by the candidate is subject to academic regulations in connection with the forfeiture of seats.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If a student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clauses 6 to 8.	Student of the college's expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to the police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying is detected based on internal evidence, such as, during valuation or special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which	

	is not covered in the above clauses 1 to 11 shall be reported to the College / University for further action to award suitable punishment.	

17. GENERAL:

- **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/fieldwork per week.
- **Credit Point:** It is the product of grade points and the number of credits for a course.
- The Academic Regulations should be read as a whole for any interpretation.
- The University/College reserves the right of altering the Academic Regulations and/or Syllabus/Course Structure, as and when necessary. The modifications or amendments may apply to all the candidates on rolls, as specified by the University/College.
- Wherever the words 'he' or 'him' or 'his' occur in the above regulations, they will also include 'she' or 'her' or 'hers'.
- Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject', 'Practical Subject' or 'Lab.' and 'Seminar'.
- In case of any ambiguity or doubt in the interpretations of the above regulations, the decision of the Vice-Chancellor will be final.

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)
M.Sc – Full Time w. e. f. 2021-22
Course structure

(PHYSICS)
SEMESTER-I

S. No	Code	Subject	L	P	Credits
1	PHYS05101	Mathematical Physics	4	0	4
2	PHYS05102	Classical Mechanics	4	0	4
3	PHYS05103	Electronic Devices	4	0	4
4	PHYS05104E PHYS05105E PHYS05106E	**Departmental Elective** a. Physics of Solar Cells b. Applied Optics c. Materials Science	4	0	4
5	PHYS05111	General Physics Lab-I	0	6	2
6	PHYS05112	Electronics Lab	0	6	2
7	PHYS05113	Seminar-I	0	4	2
		Total Credits			**22**

SEMESTER-II

S. No	Code	Subject	L	P	Credits
1	PHYS05201	Electromagnetic Theory	4	0	4
2	PHYS05202	Atomic and Molecular Physics	4	0	4
3	PHYS05203	Statistical Mechanics	4	0	4
4	PHYS05204E PHYS05205E PHYS05206E	**Departmental Elective** a. Communication Theory b. Instrumentation c. Materials Characterization Methods	4	0	4
5	PHYS05221	General Physics Lab-II	0	6	2
6	PHYS05222	Basic Simulation Lab	0	6	2
7	PHYS05223	Seminar-II	0	4	2
		Total Credits			**22**

SEMESTER-III

S. No	Code	Subject	L	P	Credits
1	PHYS05301	Quantum Mechanics	4	0	4
2	PHYS05302	Modern Physics	4	0	4
3	PHYS05303	Nuclear Physics	4	0	4
4	PHYS05304E PHYS05305E PHYS05306E	**Departmental Elective** a. Fiber Optics b. Analog Communications c. Physics of Polymers	4	0	4
5	PHYS05331	General Physics Lab-III	0	6	2
6	PHYS05332	Fiber Optics Lab	0	6	2
7	PHYS05333	Seminar-III	0	4	2
		Total Credits			**22**

SEMESTER-IV

S. No	Code	Subject	L	P	Credits
1	PHYS05401	Physics of Nanomaterials	4	0	4
2	PHYS05402	Laser Physics	4	0	4
3	PHYS05403	Solid State physics	4	0	4
4	PHYS05404E PHYS05405E PHYS05406E	**Departmental Elective** a. Fiber Optic Sensors b. Digital Communications c. Manufacturing of Engineering Materials	4	0	4
5	PHYS05441	General Physics Lab-IV	0	6	2
6	PHYS05442	Nanomaterials Lab	0	6	2
7	PHYS05443	Major Project			4
		Total Credits			**24**

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

L	T	P	C
4	0	0	4

PHYS05101 MATHEMATICAL PHYSICS

Unit I:	**Elementary Complex Analysis**
	Complex numbers, variables and functions – singularity – Analytic function, Cauchy Riemann equation – Cauchy's Integral theorem – Cauchy's Residual theorem.
Unit II:	**Matrices**
	Matrix algebra – Transpose, Inverse, Ad joint, Unitary Matrices – Eigen values and Eigen vectors – Diagonalisation
Unit III:	**Differential Equations**
	Second order linear Ordinary Differential Equation's with variable coefficients, Solution by series expansion
Unit IV:	**Special Functions**
	Legendre, Bessel, Generating functions, recursion relations, Hermite and Lagurre equations, Generating functions, recursion relations
Unit V:	**Fourier Series**
	Fourier sine and cosine series, Fourier integral and transforms, FT of delta function, Applications of Fourier Transforms**,** Integral transforms, Laplace transform, first and second shifting theorems, Inverse LT by partial fractions, LT of derivative and integral of a function.

Text Books:		
	1.	Mathematical Physics by Rajput.
	2.	Complex analysis by Churchill.

Reference Books:		
	1.	Mathematical Methods for Physics, by G.Arfken.
	2.	Mathematical Physics, A.K.Ghatak, I.C.Goyal and S.L.Chua - Macmillan India Ltd

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

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PHYS05102 CLASSICAL MECHANICS

Unit I:	**Newtonian Formalism**
	Newtonian Mechanics of one and many particle systems. Conservation laws, Work-Energy theorem. Open Systems with variable mass. D'Alembert's Principle, Generalized coordinates.
Unit II:	**Lagrangian Formalism**
	Lagrange's equations, Gyroscopic forces, Dissipative systems, Gauge invariance, invariance under Galilean transformation. Rotating frames, terrestrial and astronomical applications of coriolis force.
Unit III:	**Central Forces**
	Two-body problem, General analysis of orbits, Closure and stability of circular orbits, Kepler's laws and equations. Artificial satellites. Scattering in a central force field.
Unit IV:	**Variational Principles**
	The calculation of variations and Euler Lagrange's equations. Deduction of Hamilton's principle from D'Alembert's principle. Modified Hamilton's principle, Δ - variation. Principle of least action. Hamilton-Jacobi equation
Unit V:	**Canonical Transformations**
	Legender transformations, Generating functions, Procedure and conditions for application of canonical transformations. Poisson's brackets, Lagrange brackets. Relation between Lagrange and Poisson brackets.

Text Books:		
	1.	Classical Mechanics, by H Goldstein (Addison Wesley, 1980).
	2.	Classical Mechanics, by N C Rana and P S Joag (Tata Mc Graw-Hill.1991).
	3.	Classical mechanics, by J C Upadhyaya (HPH).

Reference Books:		
	1.	Classical Mechanics, by A Sommerfeld (Academic Press, 1952)
	2.	Introduction to classical Mechanics, by Takwale and Puranik (TMH).

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

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PHYS05103 ELECTRONIC DEVICES

Unit I:	**Semiconductor Physics**
	Charge densities in extrinsic semiconductor, Fermi Dirac Distribution, carrier concentration and fermi levels in extrinsic semiconductors semiconductor -direct and indirect band gap materials. Energy bands – carrier concentration in intrinsic semiconductors in thermal equilibrium
Unit II:	**Semiconductor Devices**
	Basic Equation for semiconductor device operation (qualitative), p-n junction diode, structure – depletion region and capacitance - junction break down – Zener diode, BJT, JFET, UJT, and MOSFET, structure, working, I-V characteristics.
Unit III:	**Photonic Devices**
	Radiative and non-radiative transitions, LED - effect of surface and indirect recombination, operation of LED, Diode lasers - conditions for population inversion in active region, light confinement factor. Optical gain and threshold current for lasing, Optical Absorption, , diode photo detectors, p-i-n photo detectors, Avalanche photo detectors, Solar cell-open circuit voltage and short circuit current, fill factor.
Unit IV:	**Microwave Devices**
	Tunnel diode, transferred electron device (Gunn diode). Avalanche Transit time device (REED diode).
Unit V:	**Memory devices**
	Static and Dynamic random access memories SRAM and DRAM, CMOS and NMOS, non-volatile – NMOS.

Text Books:		
	1.	Solid State Electronic Devices by Ben G. Streetman, Sanjay Benerjee.
	2.	Semiconductor Devices- Physics and Technology, by SM Sze Wiley (1985)

Reference Books:		
	1.	Introduction to Semiconductor devices, M.S. Tyagi, John Wiley & Sons.
	2.	Optical electronics by Ajoy Ghatak and K. Thyagarajan, Cambridge Univ. Press.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

L	T	P	C
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PHYS05104E PHYSICS OF SOLAR CELLS

Unit I:	**Solar Cell Fundamentals**
	Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell. Semiconductor properties, energy levels, basic equations. Solar cell, p-n junction, structure.
Unit II:	**PV Module Performance**
	I-V characteristics of a PV module, maximum power point, cell efficiency, fill factor, effect of irradiation and temperature
Unit III:	**Manufacturing of PV Cells & Design of PV Systems**
	Commercial solar cells - Production process of single crystalline silicon cells, multi crystalline silicon cells, amorphous silicon, cadmium telluride, copper indium gallium diselenide cells. Design of solar PV systems and cost estimation.
Unit IV:	**Classification of PV Systems and Components**
	Classification - Central Power Station System, Distributed PV System, Stand alone PV system, Grid Interactive PV System, small system for consumer applications, Hybrid solar PV system, Concentrator solar photovoltaic. System components - PV arrays, inverters, batteries, charge controls, net power meters.
Unit V:	**PV System Applications**
	Building-integrated photovoltaic units, grid-interacting central power stations, stand-alone devices for distributed power supply in remote and rural areas, solar cars, aircraft, space solar power satellites. Socio-economic and environmental merits of photovoltaic systems.

Text Books:		
	1.	Chetan Singh Solanki., *Solar Photovoltaic: "Fundamentals, Technologies and Application",* PHI Learning Pvt., Ltd., 2009
	2.	Jha .A.R, "*Solar Cell Technology and Applications"*, CRC Press, 2010.
	3.	John R. Balfour, Michael L. Shaw, Sharlave Jarosek*., "Introduction to Photovoltaics",* Jones & Bartlett Publishers, Burlington, 2011.

Reference Books:		
	1.	Luque .A. L and Andreev .V.M, "*Concentrator Photovoltaic"*, Springer, 2007.
	2.	Sukhatme .S.P, Nayak .J.K, "*Solar Energy",* Tata McGraw Hill Education Private Limited, New Delhi, 2010

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem. **L T P C**
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PHYS05105E APPLIED OPTICS

Unit I:	**E. M. Waves in a medium**
	Review of Maxwell's equations and propagation of electromagnetic waves, reflection and refraction of electromagnetic waves, total internal reflection and evanescent waves. Various states of polarization and their analysis, Anisotropic media, Plane waves in anisotropic media, Wave refractive index, Uniaxial crystals, Some polarization devices.
Unit II:	**Diffraction**
	Scalar waves, The diffraction integral, Fresnel and Fraunhofer diffraction, Single slit, Double Slit, Diffraction grating, Circular aperture, Resolving power, Diffraction of a Gaussian beam
Unit III:	**Fourier Optics**
	Basics of Fourier transform operation, Definition of spatial frequency and transmittance function, Fourier transform by diffraction and by lens, Spatial frequency filtering, types of filters, Abbe-Porter experiments, phase-contrast microscope. Holography: Principle of holography, On-axis and off-axis hologram recording and reconstruction, Types of hologram and some applications.
Unit IV:	**Coherence**
	Basics of coherence theory, spatial and temporal coherence, fringe visibility.
Unit V:	**Interferometry**
	Michelsonstellar interferometer, Optical beats, Multiple beam interference, The Fabry Perot interferometer, and its application to spectral analysis. Fourier transform spectroscopy, Laser speckles.

Text Books:		
	1.	Applied Optics and Optical Design by A. E. Conrady
	2.	Fourier Optics: An Introduction by E. G. Steward

Reference Books:		
	1.	Fundamentals of Photonics by by Bahaa E. A. Saleh and Malvin Carl Teich
	2.	Optics by Ajoy Ghatak

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

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PHYS05106E MATERIALS SCIENCE

Unit I:	**Atomic Structure and Interatomic Bonding**
	Introduction, Atomic Structure – Fundamental Concepts, Electrons in atoms, The Periodic Table, Atomic Bonding in Solids – Bonding Forces and Energies, Primary Interatomic Bonds, Secondary Bonding or vander Waals Bonding, Mixed Bonding, Molecules, Bonding Type – Material Classification.
Unit II:	**Dielectrics and Ferroelectrics**
	Macroscopic description of the static dielectric constant, the electronic and ionic polarizabilities of molecules. Orientational Polarization, Measurement or dielectric constant of a solid, the internal field of Lorentz, Clausius-Mossotti relation, elementary ideas on dipole relaxation. Classification of ferroelectric crystals- Ba TiO_3 and KDP, Dielectric theory of ferro-electricity, spontaneous polarization and ferroelectric hysteresis.
Unit III:	**Magnetic properties**
	Quantum theory of diamagnetism, origin of permanent magnetic moment, Theories of paramagnetism, paramagnetic cooling, spontaneous magnetization, Weiss theory of spontaneous magnetization, Nature and origin of the Weiss molecular field, Heisenberg exchange interaction, Hysteresis. The Block wall, Neel's theory of Antiferromagnetism. Ferromagnetism, Ferrite's and their applications (basic concepts only)**.**
Unit IV:	**Superconductivity**
	Occurrence of Superconductivity, Experimental observations, Persistent currents, Effect of magnetic fields, Meissner effect, Type I and Type II super conductors, Intermediate states, Entropy and heat capacity, energy gap, Isotope effect, Thermal conductivity. Theoretical explanations, London's equation, Penetration depth, Coherence length Cooper Pairs, Elements of BCS theory, Giaver tunneling Josophson effects (basic ideas)
Unit V:	**Fiber optics and Lasers**
	Introduction, ray theory Transmission, Types of fibers, Photo conductor, fiber optic sensors. Lasers basic concepts condition for lasing action, Ruby laser, Helium – Neon laser Semi– Conductor lasers applications.

Text Books:		
	1.	Materials science & Engineering by W.D.Callister (Jr)
	2.	Materials science by M.Arumugam

Reference Books:		
	1.	Introduction to Materials Science by Vijaykumar S. M.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

L	T	P	C
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PHYS05111 GENERAL PHYSICS LAB – I

S.No.	Name of the Experiment
1	Young's modulus of a spiral spring
2	Melde's experiment
3	Cauchy's constants for ordinary prism using white light
4	Diffraction grating using sodium light
5	Hall effect
6	B-H curve
7	e/m ratio using small bar magnet
8	Solar cell characteristics
9	Thermistor characteristics
10	Two probe method

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year I-Sem.

L	T	P	C
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PHYS05112 ELECTRONICS LAB

S.No.	Name of the Experiment
1	Characteristics of P-N junction diode
2	Characteristics of Zener diode
3	Zener diode applications as voltage regulator
4	Transistor characteristics - Common emitter
5	Characteristics of Photodiode
6	Characteristics of FET
7	RC phase shift oscillator
8	UJT Characteristics
9	Characteristics of LED
10	Photo transistor characteristics

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem. **L T P C**
4 0 0 4

PHYS05201 ELECTROMAGNETIC THEORY

Unit I:	**Maxwell's Equations**
	The equation of continuity for Time-Varying Fields – Inconsistency of Ampere's Law – Maxwell's equations – Conditions at a Boundary surface.
Unit II:	**Electromagnetic Waves**
	Solution for free-space conditions – Uniform plane – Wave propagation – Uniform plane waves – The Wave Equation for a conducting medium – Sinusoidal Time Variations – Conductors and Dielectrics – Polarization – Directions cosines.
Unit III:	**Reflection by a Perfect Conductors and Poynting Vector**
	Reflection by a perfect conductors normal incidence – Reflection by a perfect conductor – Oblique Incidence – Reflection by a perfect Dielectric – Normal Incidence – Reflection by a perfect Insulator – Oblique Incidence – Reflection at the surface of a conductive medium – Surface impedance – The Transmission – line Analogy - Poynting Vector and the flow of power, Poynting's theorem
Unit IV:	**Guided Waves**
	Waves between parallel planes – Transverse Electric Waves – Transverse Magnetic Waves Characteristics of TE and TM Waves – Transverse Electromagnetic Waves – Velocities of propagation – Attenuation in parallel – plane Guides – Wave Impedances – Electric Field and current Flow within the conductors – Transmission lines - Circuit Representation of the parallel-plane transmission line, parallel – plane Transmission lines with loss – E and H about Long parallel cylindrical conductors of Arbitrary cross section.
Unit V:	**Wave Guides**
	Rectangular guides – Transverse Magnetic waves in Rectangular guides – Transverse electric waves in rectangular guides – Impossibility of TEM wave in wave guides – Bessel functions – Solution of the Field equation – Cylindrical co-ordinates – TM and TE waves in circular guides – wave impedances and characteristics impedance– Attenuation factor of wave guides.

Text Books:		
	1.	Electromagnetic wave and Radiating Systems, 2nd Edition, Edward C. Jordan, Keith G. Balmain.
	2.	2000 solved problems in Electromagnetics, Syed Nasar, Schaum Series

Reference Books:		
	1.	Introduction to Electrodynamics – D.J.Griffith –PHI (1998).

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem.

L	T	P	C
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PHYS05202 ATOMIC AND MOLECULAR PHYSICS

Unit I:	**Introduction to the Quantum Theory and Bohr Atom**
	Review of solution of Schrodinger's equation for Coulomb field and Hydrogen atom, Bohr Somerfield theory of Hydrogen Atom, Angular momentum & Parity, Dipole approximation, Magnetic dipole moments, Electron spin and Vector atom model, Spin orbit Interaction, Stern-Gerlach experiment, Hydrogen fine structure.
Unit II:	**Fine structure of Hydrogen like atoms**
	Spin-Orbit Interaction, Relativistic Correction, Lamb Shift. Interaction with External Fields- Zeeman Effect, Paschen-Back and Stark effects. Many-electron atoms- LS-coupling approximation, J-J coupling, Hyperfine structures, Lande Interval rule. The idea of Hartree-Fock equations.
Unit III:	**Born-Oppenheimer Approximation, Rotational spectroscopy**
	Rigid rotor, Rotational spectra of diatomic molecules, Intensities of spectral lines, Isotope effects, Non-Rigid Rotator, Rotation levels of polyatomic molecules: spherical, symmetric, and Asymmetric top molecules. Vibrational spectroscopy: Vibration of diatomic molecules, Harmonic oscillator and Anharmonic oscillator.
Unit IV:	**Electronic spectroscopy**
	Electronic spectra of diatomic molecules, vibrational coarse structure, Franck-Condon Principle, Dissociation energy and dissociation products, Rotational fine structure of Electronic-Vibration transition, Production of excited state.
Unit V:	**Radiative processes**
	Selection rules, Frank-Condon principle, Jablanski diagram and qualitative treatment of small molecule and large molecule limit for nonradiative transitions, Raman Effect. Idea of Symmetry elements and point Groups for diatomic and polyatomic molecules.

Text Books:		
	1.	Introduction to Atomic Spectra, by Harvey Elliott White McGraw-Hill 1934
	2.	Elementary Atomic Structure by G.K. Woodgate Mc Graw-Hill
	3.	Molecular Spectra by G. Herzberg

Reference Books:		
	1.	Fundamentals of Molecular Spectroscopy by C.N. Banwell
	2.	J.R. Lakowicz: Principles of fluorescence spectroscopy Springer, 1983
	3.	K. Shimoda : Introduction to Laser Physics

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem.

L	T	P	C
4	0	0	4

PHYS05203 STATISTICAL MECHANICS

Unit I:	**Basics of Statistical Mechanics**
	Objective of Statistical Mechanics, Macrostates, Microstates, Phase space, Concept of Ensembles, Ensemble average, Liouville theorem, Conservation of extension in phase, Equation of motion and Liouville theorem, Equal a prior probability, statistical equilibrium, Microcanonical ensemble, Ideal gas, Quantization of phase space
Unit II:	**Thermodynamics**
	Entropy, Equilibrium conditions, Quasistatic processes, Entropy of an ideal Boltzmann gas using the micro canonical ensemble, Gibbs paradox, Sackur-Tetrode equation, Entropy and probability. canonical ensemble, Entropy of a system in contact with a heat reservoir, Ideal gas in canonical ensemble, Maxwell velocity distribution, Equipartition of energy.
Unit III:	**Grand Canonical Ensemble**
	Ideal gas in grand canonical ensemble, comparison of micro canonical, canonical and grand canonical ensembles,Canonical partition function, Molecular partition functions, Translational partition function, Rotational partition function, Vibrational partition function.
Unit IV:	**Ideal Bose-Einstein Gas**
	Bose-Einstein distribution, Bose-Einstein condensation, liquid helium, Two-fluid model of liquid helium II.
Unit V:	**Ideal Fermi-Dirac Gas**
	Fermi-Dirac distribution, Degeneracy, electrons in metals, Thermionic emission, Magnetic susceptibility of free electrons.

Text Books:		
	1.	Statistical Mechanics By B.K. Agarwal & Melvin Eisner
	2.	Statistical Mechanics By E.S Raja Gopal

Reference Books:		
	1.	Statistical Mechanics by Battacharya.
	2.	Fundamentals of Statistical and Thermal Physics by Frederick

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem.

L	T	P	C
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PHYS05204E COMMUNICATION THEORY

Unit I:	**Introduction to Fourier Series**
	Signal analysis, The sampling function, Response of a linear system, normalized power, normalized power in Fourier Expansion, Fourier Transform, Fourier transforms of discrete functions.
Unit II:	**Amplitude Modulation Systems**
	Frequency translation, A method of Frequency translation, recovery of baseband signal-Synchronous detection, Amplitude modulation-Envelope detection, spectrum of an amplitude modulated signal, modulators and balanced modulators-DSB, Single sideband modulation (SSB), Vestigial Side band modulation (VSB), Multiplexing.
Unit III:	**Frequency Modulation System**
	Angle modulation, Phase and frequency modulation, spectrum of an FM signal-Sinusoidal Signal, Some features of Bessel coefficients, Phasor diagram of FM Signal, Reactive Modulators, FM demodulators
Unit IV:	**Pulse Modulation Systems**
	Sampling theorem. Types of sampling. Principles of PAM, PWM methods. Pulse code modulation. Delta modulation.
Unit V:	**Noise**
	Thermal noise, shot noise, noise power spectral density, Noise figure and noise temperature. Available gain. Noise figure of a single amplifier.

Text Books:		
	1.	S.S. Haykins communication System, Wiley Ester.
	2.	Taub and Schilling – Principles of Communication – T.M.H

Reference Books:		
	1.	A.B. Carlson, Communication Systems (I S E).

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem. **L T P C**
4 0 0 4

PHYS05205E INSTRUMENTATION

Unit I:	**Compositional and Structural Characterization Techniques**
	X-ray Photoelectron Spectroscopy (XPS), Energy Dispersive X-ray analysis (EDAX), Principles and applications of X-ray diffraction: Electron diffraction, Electron probe microanalysis (EPMA), Ion beam techniques: SIMS & RBS.
Unit II:	**Surface Characterization Techniques**
	High resolution microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy(TEM), Atomic force microscopy(AFM), Scanning tunneling microscopy(STM).
Unit III:	**Spectroscopic Techniques**
	Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy techniques: micro Raman and laser Raman.
Unit IV:	**Electrical Characterization Techniques**
	Measurement of resistivity by 4-prob method, Hall measurement, Seebeck coefficient measurements, nano indentation techniques, electron beam induced current measurement (EBIC).
Unit V:	**Thermal and Magnetic Characterization**
	VSM, Thermal analysis, impedance and ferroelectric measurements.

Text Books:		
	1.	Nano: The Essentials -Understanding Nano Scinece and Nanotechnology by T. Pradeep,
	2.	Introduction to Nano Technology by Charles. P. Poole Jr. and Frank J. Owens,
	3.	A practical approach to X-Ray diffraction analysis by C. Suryanarayana

Reference Books:		
	1.	Nanotechnology: Principles and Practices – Sulabha K. Kulkarni
	2.	Specimen preparation for Transmission Electron microscopy by John & Bravmno et al,

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem. **L T P C**
4 0 0 4

PHYS05206E MATERIAL CHARACTERIZATION METHODS

Unit I:	**Physical Characterizations**
	Particle size/shape/distribution, Surface area, Porosity, Density, Flow property.
Unit II:	**Chemical Characterizations**
	Elemental analysis (EDS/WDS/EPMA), Raman, IR/FTIR, UV-Vis, SIMS, XPS.
Unit III:	**Electrical, Electronic and Dielectric Characterizations**
	I-V, C-V, carrier type and concentration, Dielectric constant and its temp dependence, capacitance and loss factor, Impedance spectroscopy.
Unit IV:	**Ferroelectric and Magnetic Characterizations**
	Electric field dependence of Polarization (P-E loop), piezoelectric coefficients, M vs H, M vs T, Magnetic permeability/susceptibility, energy product etc.
Unit V:	**Thermal and Optical Characterizations**
	DTA, TGA, DSC, Thermal conductivity, Thermal expansion, PL, Ellipsometry etc.

Text Books:		
	1.	. “Materials Characterization Techniques” by Sam Zhang, Lin Li, and Ashok Kumar CRC Press, Taylor and Francis Group
	2.	“Physical Methods for Materials Characterization” by Peter E. J. Flewitt and Robert K Wild, CRC Press, Taylor and Francis Group
	3.	“Concise Encyclopedia of Materials Characterization”, ed. Robert W Cahn and Eric Lifshin, Pergamon Press.

Reference Books:		
	1.	Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Y. Leng.
	2.	Practical Materials Characterization, M. R. Sardela, Springer.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem.

L	T	P	C
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PHYS05221 GENERAL PHYSICS LAB - II

S.No.	Name of the Experiment
1	Young's modulus- bending of beam (Uniform & Non-uniform)
2	Diffraction by single slit using sodium light
3	Photo cell- Planck's constant using filters
4	Polarimeter- Specific rotatory power of sugar solution
5	Stefan's constant
6	Heating efficiency of a kettle
7	Compound pendulum
8	Viscosity of liquids using oscillating disc method
9	LASER characteristics
10	Magnetic Susceptibility of solid

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics I Year II-Sem.

L	T	P	C
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PHYS05222 BASIC SIMULATION LAB

S.No.	Name of the Experiment
1	Generation of Various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
2	Operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3	Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal.
4	Convolution of Signals and sequences.
5	Auto Correlation and Cross Correlation of Signals and Sequences.
6	Verification of Linearity and Time Invariance Properties of a given Continuous/Discrete System.
7	Sinusoidal responses of the given LTI system and verifying its realiazability and stability properties.
8	Gibbs Phenomenon verification
9	Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
10	Waveform Synthesis using Laplace Transform.

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

L	T	P	C
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PHYS05301 QUANTUM MECHANICS

Unit I:	**Fundamental Concepts**
	Inadequacy of classical mechanics, Schrodinger equation, continuity equation, Ehrenfest theorem, Admissible wave functions, Stationary states - One-dimensional problems, wells and barriers, Harmonic oscillator by Schrodinger equation and by operator method.
Unit II:	**General Formalism**
	Uncertainty relation of x and p, states with minimum uncertainty product, General formalism of wave mechanics, Commutation relations, Representation of states and dynamical variables, Dirac delta function, bra and ket notation, Matrix representation of an operator.
Unit III:	**Angular momentum Formalism**
	Angular momentum in QM, Central force problem: Solution of Schrodinger equation for spherically symmetric potentials, Hydrogen atom
Unit IV:	**Time dependent Perturbation**
	Time-independent perturbation theory, Non-degenerate and degenerate cases, Applications such as Stark effect - Variational method: WKB approximation and time dependent perturbation theory.
Unit V:	**Relativistic Quantum Mechanics**
	Klein Gordon equation – plane wave solutions and equation of continuity – Dirac equation – probability density – Dirac matrices – Plane wave solutions – Significance of negative energy states – spin of the Dirac particle – Dirac particle in electromagnetic fields – Dirac equation in covariant form – Gamma matrices.

Text Books:		
	1.	L I Schiff, Quantum Mechanics (McGraw-Hill).
	2.	Mathews and Venkateshan, Quantum Mechanics.

Reference Books:		
	1.	Quantum mechanics by E.Merzbacher (Wiley 1970).
	2.	B Craseman and J D Powell, Quantum Mechanics (Addison Wesley).

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

L	T	P	C
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PHYS05302 MODERN PHYSICS

Unit I:	**Origins of Quantum Physics**
	Blackbody Radiation and h, Photoelectric effect, X Rays, Compton scattering, atomic spectra Bohr atom - quantization of energy, Electron waves, travelling wave propagation, medium and EM fields, Standing waves in the Bohr atom, Electron wave packets, Heisenberg uncertainty
Unit II:	**Electromagnetic Waves**
	Equation of continuity, Maxwell's equations, Maxwell's equations in integral and differential forms, Physical Significance, Pointing theorem, Poynting vector, The wave equation, plane Electromagnetic wave in free space, plane Electromagnetic wave in anisotropic non conducting medium, plane Electromagnetic wave in isotropic non conducting medium, plane Electromagnetic wave in conducting medium
Unit III:	**Defects in Solids**
	Introduction, classification of imperfections, point defects; vacancies, impurities, interstitials, color centues, Schottkey defects, Frenkel defects. Estimation of concentration of Schottkey defects and Frenkel defects at a given temperature. Line Defects: Edge dislocation, Screw dislocation, Burger's circuit and Burger's vector.
Unit IV:	**Super conductors**
	Super conducting phenomenon, Zero electrical resistance, Meissner's effects, magnetic phase diagram, energy gap, isotope effect, flux quantization, Josephson effect and tunneling, SOULD, London equations, BCS theory, application of superconductors.
Unit V:	**Photonic devices**
	Light emitting diodes, photo diode, solar cells, photo transistor.

Text Books:		
	1.	EM Waves and Radiating Systems by Edward C.Jordon Keith G. Balmain
	2.	Electro magnetic theory and Electrodynamics by Satya Prasad

Reference Books:		
	1.	Introduction to solid state physics by C.Kittel
	2.	Physics of Semiconductor Devices by S.M.Sze.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

L	T	P	C
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PHYS05303 NUCLEAR PHYSICS

Unit I:	**Nuclear Forces**
	Properties of Nuclear forces – Non central forces, Exchange forces and tensor forces- Meson theory of nuclear forces- Nucleon – nucleon scattering- Effective range theory – Spin dependence of nuclear forces – Isospin formalism.
Unit II:	**Nuclear Reactions**
	Direct and compound nuclear reaction mechanisms – Cross sections in terms of partial wave amplitudes – Compound nucleus – Scattering Matrix – Reciprocity theorem – Breit – Wigner one – level formula – Resonance scattering.
Unit III:	**Nuclear Models**
	Liquid drop model – Bohr – Wheeler theory of fission – Experimental evidence for shell effects – Shell model – Spin – Orbit coupling – Magic numbers – Angular momenta and parities of nuclear ground states –estimate of transition rates(Qualitative) - magnetic moments and Schmidt lines- Collective model of Bohr and Mottelson.
Unit IV:	**Nuclear Decay**
	Beta decay – Fermi theory of beta decay –Total decay rate- Angular momentum and parity selection rules- Comparative half – lives – Allowed and forbidden transitions – Selection rules – Parity violation – Two component theory of neutrino decay – Detection and properties of neutrino.
Unit V:	**Elementary Particle Physics**
	Types of interaction between elementary particles – Hadrons and leptons – Symmetry and conservation laws – Elementary ideas of CP and CPT invariance –Classification of hadrons .Quark Model- bottom and top quarks, Electromagnetic structure of nucleons

Text Books:		
	1.	Nuclear Physics, Tayal
	2.	I.Kaplan, Nuclear Physics, 2nd Ed., Narosa, Madras, 1989

Reference Books:		
	1.	Introductory Nuclear Physics by W.Wong.
	2.	Introductory Nuclear Physics by S.B.Patel.

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JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem. **L T P C**
4 0 0 4

PHYS05304E FIBER OPTICS

Unit I:	**Propagation in Fiber**
	Introduction to Fiber propagation using a Ray Model, Material Dispersion. Refractive index theory of a bulk media, Experimental values, Time dispersion in bulk media, The combined effect of Material & Multipath Dispersion, RMS pulse widths and frequency Response.
Unit II:	**Fabrication & Assessment of Fibers**
	Fiber production Methods- Double crucible method, Vapor axial deposition (VAD) method, MCVD method, Cables, Splices & connectors, Attenuation Mechanisms in optical fibers.
Unit III:	**Wave Propagation in Step Index Fibers**
	Modes and Rays, Wave Propagation modes in an ideal step-index Filter, solution of wave equation, solution for propagation constant, variation of propagation constants with frequency, Weakly guiding solutions, Types of single mode fibers.
Unit IV:	**Wave Propagation in Graded Index Fibers**
	Modes in graded- Index Fibers, The equivalence of the WKB Approximation & Ray Modal. Intermode Dispersion in graded-Index Fibers, Intramode Dispersion in graded-Index Fibers. Total Dispersion in Graded Index Fibers.
Unit V:	**Optical Amplifiers**
	Basic applications and types of optical amplifiers, semiconductor optical amplifiers, raman amplifiers, Erbium doped fiber amplifiers, amplifier noise, system application.

Text Books:		
	1.	Optical Communication System – John Gowar
	2.	Optical Fiber Communications – John M Senior

Reference Books:		
	1.	Optical Fiber Communications by D J Keiser
	2.	Introduction to Fiber Optics by Ajoy Ghatak & K. Thyagarajan

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

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PHYS05305E ANALOG COMMUNICATION

Unit I:	**AMPLITUDE MODULATION**
	Introduction to communication systems, Need for modulation, Frequency Division Multiplexing, Amplitude Modulation, Time domain and frequency domain description, Generation of AM waves, square law modulator, detection of AM waves, Square law detector, Envelop detector, Double sideband suppressed carrier modulators
Unit II:	**SSB MODULATION**
	Introduction to Hilbert transform, Frequency domain description, Frequency discrimination method for generation of AM SSB Modulated wave, Time domain description, Phase discrimination method for generating AM SSB Modulated waves, demodulation of SSB waves, vestigial sideband modulation.
Unit III:	**ANGLE MODULATION**
	Basic concepts, frequency modulation, single tone frequency modulation, spectrum analysis of sinusoidal FM wave, Narrow band FM, Wideband FM, Constant average power, transmission bandwidth of FM wave-generation of FM waves, direct FM, Detection of FM waves.
Unit IV:	**NOISE**
	Resistive noise source(thermal), arbitrary noise sources, effective noise temperature, average noise figures, average noise figure of cascaded networks, narrowband noise, Noise in analog communication system, noise in DSB and SSB System, Noise in AM system.
Unit V:	**RECEIVERS**
	Radio receiver-receiver types, tuned radio frequency receiver, super heterodyne receiver, RF Section and characteristics- frequency changing and tracking, intermediate frequency, AGC, FM receiver, comparison with AM receiver, amplitude limiting, Pulse modulation- types of pulse modulation

Text Books:		
	1.	Communication Systems by Simon Haykins, John wiley & Sons, IV Edition
	2.	Electronic communications – Dennis Roddy & John Coolean, IV Edition, PEA, 2004
	3.	Communications Systems – B.P.Lathi, BS Publicaions, 2004

Reference Books:		
	1.	Analog and Digital Communications-Simon Haykins, John Wiley, 2005.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem. **L T P C**
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PHYS05306E PHYSICS OF POLYMERS

Unit I:	**Introduction to Polymers**
	Introduction to polymers, classification of polymers thermoplastics and Thermosets, glass transition temperature (Tg) melting temperature (Tm), control of Tm and Tg and relation between them, Dependence of Tm and Tg on copolymer composition.
Unit II:	**Polymer Structures**
	Introduction, Hydrocarbon Molecules, Polymer Molecules, The chemistry of Polymer Molecules, Molecular Weight, Molecular Shape, Molecular Structure, Molecular Configurations, Thermoplastic and Thermosetting Plymers, Copolymers, Polymer Crystellinity, Polymer Crystals.
Unit III:	**Classification of Polymers**
	Polymer additices: Plastioizers, and reinforce other important additives: Stabilizers, flame retardants, Biocious colorants, Polymer blends, polymer composites, properties, toughened plastics and phase separated blends.
Unit IV:	**Analysis of Polymers**
	Analysis and testing of polymer by spectroscopic memory Infrared spectroscopy, nuclear magnetic resonance, X-ray diffraction Thermal analysis of polymer: Differential scanning calorimetry, Differential Thermal Analysis and Thermo gravimetric method.
Unit V:	**Super Ionic Solids**
	Super Ionic solids, classification, Ionic Transport, Ion Dynamics, Polymer electrolytes and their advantages, Applications with special reference to batteries.

Text Books:		
	1.	An Introduction to polymer physics-I by Perepechko
	2.	Polymer science and technology-by Joel.R.Fried

Reference Books:		
	1.	Text Book of polymer Science by Fred W Billmeyer,
	2.	Super ionic solids by S. Chandra

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

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PHYS05331 GENERAL PHYSICS LAB - 3

S.No.	Name of the Experiment
1	Refractive index of ordinary and extra-ordinary ray using calcite prism
2	Dielectric constant of given material
3	Abbey's Refractometer using different liquids and different concentrations
4	Specific heat of solids
5	Photo elastic constant by Newton's rings
6	Ultrasonic diffraction using quartz crystal
7	Four probe method
8	Planck's constant using LED
9	Magnetic Susceptibility of a liquid
10	Linear expansion of metal using parallel fringes

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year I-Sem.

L	T	P	C
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PHYS05332 FIBER OPTICS LAB

S.No.	Name of the Experiment
1	Losses in optical fiber at 660nm and 850 nm
2	Characterization of 660nm and 850 nm LEDs
3	Angular misalignment
4	Longitudinal and lateral misalignment losses
5	Characterization of fiber optic phototransistor
6	Measurement of numerical aperture
7	Setting up of fiber optic voice link
8	Forming PC to PC communication link using optical fiber and RS-232 interface
9	Study of pulse width modulation and demodulation
10	Study of an eye pattern

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

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PHYS05401 PHYSICS OF NANOMATERIALS

Unit I:	**Introduction**
	An overview of quantum mechanical concepts related to low dimensional system-wave particle duality, de-Broglie wavelength, Quantum confinement, time-dependent and time- independent Schrodinger equation, particle in a box.
Unit II:	**Concepts related to Electronic Structure**
	Three-dimensional and two dimensional direct lattice, packing fraction, Reciprocal lattice, Brilloujn zones, , Diffraction from 2D structures, Free — electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for one, two, and three dimensional electron gas, Energy bands, Direct- and Indirect- gap semiconductors, Effective mass.
Unit III:	**Hetero-structures and Electron states**
	Heterojunctions, Type I and Type II heterostructures, Classification of Quantum confined systems, Electrons and holes in Quantum wells, Electronic wave functions, energy sub-bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Coupling between Quantum wells, Super lattices, Excitons.
Unit IV:	**Nanoclusters and Nanoparticles**
	Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotransition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters.
Unit V:	**Carbon Nanostructures and Bulk Nanostructures Materials**
	Introduction to Carbon molecules and clusters, Structure of and_C60 its crystal, Small and Large Fullerenes and Other Bucky balls, Carbon nanotubes and their Electronic structure. Solid disordered nanostructures, Nanostructured crystals, photonic crystals.

Text Books:		
	1.	Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens. Wiley India Pvt. Ltd.
	2.	Solid State physics by Pillai, Wiley Eastern Ltd.

Reference Books:		
	1.	Hand book of Nano structured materials Vol I & V
	2.	Encyclopedia of Nano Technology by H.S.Nalwa

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

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PHYS05402 LASER PHYSICS

Unit I:	**The Einstein Coefficients And Light Amplification**
	Introduction, The Einstein Coefficients, Quantum Theory for the evaluation of the Transition Rates and Einstein Coefficients, More Accurate delution for the Two-Level System, Line Broadening Mechanisms, Saturation behavior of Homogeneously and In homogeneously Broadened transitions.
Unit II:	**Laser Rate Equation And Semi classical Theory Of The Laser**
	The Tree-level system, Four-level System, variation of Laser Power around Threshold. Optimum output coupling, Laser spiking, cavity modes polarization of the cavity medium First- order Theory and Higher- order Theory.
Unit III:	**Optical Resonators**
	Modes of rectangular cavity and the open planar resonator, Confocal Resonator, The Quality Factor, Ultimate line width of the Laser, Transverse and Longitudinal mode selection , Q-switching, mode locking in lasers, , Geometrical Optic Analysis of Optical Resonators.
Unit IV:	**Interaction Of Radiation Field With Matter**
	Quantization of the electromagnetic field, Eigenkets of the Hamiltonian, The coherent states, Transition Rates, the Phase-Operator, Coherence properties of Laser Light, The Ruby, Helium Neon Laser, solid state Laser, Carbon Dioxide Laser, Dye Lasers, Semiconductor Lasers.
Unit V:	**Applications**
	Spatial Frequency Filtering, Holography, Laser Energy Requirements. Laser-Induced Fusion Reaction. Large information – carrying capacity of light waves, Light wave Communication System (optical Fiber, Modulators and Detectors). Harmonic Generation, Stimulated Raman Emission.

Text Books:		
	1.	Lasers by K. Thygarajan and A.K.Ghatak.
	2.	Optical Electronics by Thygarajan and A.K. Ghatak
	3.	Lasers : Siegman

Reference Books:		
	1.	Optical Electronics by Yariv.
	2.	Opto Electronics by Milson.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

L	T	P	C
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PHYS05403 SOLID STATE PHYSICS

Unit I:	**Crystal Physics**
	Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, closed packed structures. Interaction of X-rays with matter, absorption of X-rays. Elastic scattering from a perfect lattice. The reciprocal lattice and its applications to diffraction techniques. The Laue, powder diffraction methods, crystal structure factor.
Unit II:	**Defects in Crystals**
	Point defects, line defects and planar (stacking) faults, estimation of Schottky and Frenkel defects, edge and screw dislocations-Burger vectors. The role of dislocations in plastic deformation and crystal growth- The observation of imperfections in crystals, X-ray and electron microscopic techniques.
Unit III:	**Electronic Properties of Solids**
	Electrons in a periodic lattice, Bloch theorem, band theory(Kronig –Penny model), Brillouin Zones, classification of solids, effective mass of electron, Tight-bonding, cellular and pseudo potential methods
Unit IV:	**Superconductivity**
	Fermi surface, de Hass von Alfen effect, cyclotron resonance, magneto-resistance, quantum Hall effect. Superconductivity: critical temperature, persistent current, Meissner effect.BCS theory, Applications of superconductors
Unit V:	**Magnetic Properties**
	Weiss theory of ferromagnetism. Heisenberg model and molecular field theory. Spin waves a magnons and spintronics, Curie-Weiss law for susceptibility, Ferri- and anti ferromagnetic order. Domains and Bloch-wall energy.

Text Books:		
	1.	Verma and Srivastava: crystallography for Solid State Physics.
	2.	Solid State Physics by A.J. Dekker.
	3.	Omar: Elementary Solid State Physics

Reference Books:		
	1.	Introduction to Solids: Leonid V. Azaroff
	2.	Introduction to Solid State Physics by Charles Kittel.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

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PHYS05404E FIBER OPTIC SENSORS

Unit I:	**Intensity Modulated Sensors**
	General features, intensity modulation through interruption, shutter/schliren multimode fiber Optic sensors, Reflective fiber optic sensors, Evanescent – Wave fiber sensors, Microband sensors, Fiber Optic refractometers, Intensity modulated fiber optic thermometers, chemical analysis, Distributed sensing with fiber optics.
Unit II:	**Interferometric Sensors**
	Basic principles of interferometric optical fiber sensors, Applications of interferometric optical fiber sensors, components for interferometric sensors, Future trends in interferometric sensors.
Unit III:	**Fused Single Mode Couplers**
	Introduction, physical principles, polarization effects, Experimental properties-Wavelength dependence, dependence on external refractive index, Theoretical modeling - Qualitative behavior, first approximation, second approximation, comparison with experiment, dependence on external refractive index.
Unit IV:	**Single – Mode All Fiber Components**
	Directional, couplers, fused single mode couplers, polished single mode couplers, polarization splitters, polarization controllers, optical isolators, single mode fiber filters
Unit V:	**Signal Processing in Mono-mode Fiber Optic Sensor Systems**
	Transduction mechanisms – sensor transfer function, Phase modulated sensors, polarization modulated sensors, Optical processing – Two beam Interferometer, Multiple beam interferometer.

Text Books:		
	1.	Fundamentals of Fiber Optics in Telecommunications and sensor systems - Edited by Bishnu P. Pal.
	2.	Introduction to fiber Optics by Ajoy Ghatak and K. Thyagarajan

Reference Books:		
	1.	Fiber-Optic Communications Technology by Djafar K. Mynbaev, Lowell L. Scheiner

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem. **L T P C**
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PHYS05405E DIGITAL COMMUNICATIONS

Unit I:	**Elements of Digital Communication Systems**
	Modal of digital communication Systems, Digital Representation of Analog Signal, Certain Issues in Digital Transmission, Advantages of Digital Communication Systems, Sampling Theorem, Types of Sampling – Impulse Sampling, Natural Sampling, Flat –Top Sampling, Introduction to baseband Sampling, PCM Generation and Reconstruction.
Unit II:	**Digital Modulation Techniques**
	Introduction, ASK, ASK Modulator, Coherent ASK Detector, Non-Coherent ASK Detector, FSK, Bandwidth and Frequency Spectrum of FSK, Non –Coherent FSK Detector, Coherent FSK Detector, FSK Detection using PLL, BPSK, Coherent PSK Detection, QPSK, Differential PSK.
Unit III:	**Baseband transmission and optimal reception of Digital Signal**
	A Baseband signal receiver, Probability of error, Optimum receiver, Coherent reception, Signal space representation and probability of error, Eye diagrams, cross talk.
Unit IV:	**Entropy information rate, Source Coding**
	Huffman coding, Shannon Fano coding, Mutual Information, Channel capacity of discrete channel, Shannon Hartley law, Trade of between bandwidth and SNR
Unit V:	**Error Control Codes**
	Linear block codes, Matrix description of linear block codes, Error detection and Error correction capabilities of linear block codes, Cyclic codes- Algebraic structure, Encoding, Syndrome calculation, Decoding. Convolution codes, encoding, decoding using state, tree and trellis diagrams, decoding using viterbi Algorithm, Comparison of error rates in coded and un-coded transmission

Text Books:		
	1.	Principles of Communication Systems: Herbert Taub, Donald L Schilling, Goutam Saha, III Edition, Mcgraw-Hill, 2008.
	2.	Digital and Analog Communication Systems: Sam Shanmugam, John Wiley, 2005.

Reference Books:		
	1.	Digital Communications-Ian A. Glover, Peter M. Grant, II Edition, Pearson Edu.,
	2.	Communications Systems – B.P.Lathi, BS Publicaions, 2006.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem. **L T P C**
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PHYS05406E MANUFACTURING OF ENGINEERING MATERIALS

Unit I:	**Introduction to Materials**
	Basics of metals, ceramics, polymers, glasses, quasicrystals, amorphous solids, composites, hybrid materials, graphite, diamond, graphene, nanotubes. The evolution of engineering materials, design limiting properties such as density, cost, mechanical, thermal, wear, corrosion/oxidation etc.
Unit II:	**Selection criteria for different engineering applications**
	Automotive, aerospace, marine etc. Data driven selection approach using the Ashby charts for various engineering applications. Casting processes.
Unit III:	**Forming Processes**
	Forming processes such as rolling, extrusion, forging, sheet metal forming, formability, powder based manufacturing processes, single crystal development etc.
Unit IV:	**Joining Processes**
	Various joining processes (fusion as well as solid state methods), advanced machining processes, fabrication of micro and nano scale systems. Principles of subtractive manufacturing and additive manufacturing, opportunities, limitations.
Unit V:	**Applications**
	Considerations w. r. t technology development based on application, economics and deployment, Selective case studies.

Text Books:		
	1.	Materials selection in mechanical design, M. F. Ashby, fourth edition, Elsevier, 2011.
	2.	Manufacturing Engineering and Technology, S. Kalpak jian, S. R. Schmid, Pearson, 2002.

Reference Books:		
	1.	Materials for Engineering, Third Edition, John Martin, CRC Publishers
	2.	Material Science & Technology, Edited by Sabar D. Hutagalung, Intech Web.ORG

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

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PHYS05441 GENERAL PHYSICS LAB - 4

S.No.	Name of the Experiment
1	Rydberg constant
2	Thermo electric power
3	Coefficient of thermal expansion of solids
4	P-E hysteresis loop of a ferroelectric crystal
5	Velocity of ultrasonic waves in organic liquids using interferometer
6	Refractive index of liquids using Hallow prism
7	Diffraction grating using laser
8	e/m of an electron using helical method
9	Characteristics of a Ni-Cad battery using solar photovoltaic cell
10	Study of conversion of mechanical energy to heat energy

Note: Any 8 experiments are to be performed by each student

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Sc. Physics II Year II-Sem.

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PHYS05442 NANOMATERIALS LAB

S.No.	Name of the Experiment
1	Synthesis of CuO nanoparticles using Glycine as fuel by Solution combustion method
2	Synthesis of CuO nanoparticles using Ascorbic acid as fuel by Solution combustion method
3	Verification of BEER-LAMBERT's law using colorimeter
4	Preparation of Cobalt nanoparticles by wet chemical reduction method
5	Synthesis of ZnO nanoparticles using Glycine as fuel by Solution combustion method
6	Synthesis of ZnO nanoparticles using Ascorbic acid as fuel by Solution combustion method
7	Synthesis of silica gel (SiO2) using SOL-GEL method
8	Preparation of Gold nanoparticles by wet chemical reduction method
9	Synthesis of PVP capped Cadmium Sulfide (CdS) nanoparticles by chemical coprecipitation method
10	Conductometry

Note: Any 8 experiments are to be performed by each student