BANGALORE UNIVERSITY

Jnana Bharathi, Bangalore-560 0 56

No. Aca.II/CBCS/2014

Date: 29/11/2014

To

1. The Deans of Faculties, Bangalore University
2. The Chairpersons/Directors/Coordinators of Departments of Studies/Boards of Studies,Bangalore University,
3. The Principals of Colleges affiliated to Bangalore University.

Madam/Sir,

Sub: UGC Guidelines on adoption of Choice Based Credit System.
Ref: Letter D.O. No. F.1-1/2014 (Secy), dated 12th November, 2014 from the Secretary, UGC, New Delhi.

This is to inform that the UGC has embarked on numerous measures to enhance efficiency and excellence in the higher education system in the country. The reforms undertaken in this regard have led to noticeable improvement in the standards of education. However, because of the diversity in the evaluation system followed by different Universities in India, students have suffered acceptance of their credentials, at times, across the University system, as well as the employment agencies.

In order to mitigate this procedure, the UGC has formulated Guidelines on adoption of Choice-Based Credit System (CBCS) by all the Universities. This would ensure seamless mobility of students across the higher education institutions in the country as well as abroad. The credits earned by the student may be transferred and would be of great value to the students in the event of their seeking migration from one institution to the other. You are requested to access the Guidelines from the UGC website www.ugc.ac.in.

It may be kindly be noted that Bangalore University has already introduced Choice Based Credit System in the Undergraduate and Postgraduate Courses from the academic year 2014-15 and the draft Regulations in this regard have already been circulated to all the Principals. Necessary modifications to the draft Regulations will be made as per the present UGC Guidelines and will be sent to the State Government for approval and the same will be circulated to all the concerned.

Yours faithfully,

REGISTRAR 29/11/14

ST FRANCIS DE SALES COLLEGE BANGALORE

PRINCIPAL
St. Francis de Sales College
Electronics City Post, Bangalore - 560 100

IQAC

BANGALORE UNIVERSITY

PROCEEDINGS OF THE EXTRA-ORDINARY MEETING OF THE ACADEMIC COUNCIL HELD ON 13-08-2014 AT 2.30 P.M. IN THE SENATE HALL, BUB.

Members Present:

1.	Prof. B. Thimmegowda, Vice-Chancellor	Ex-Officio- Chairman
2.	Mr. Ramachandra Gowda, MLC	Member
3.	Dr. Rajesh. E.B.	Member
4.	Dr. N. Ramachandraswamy	Member
5.	Mrs. Prabhavathi Bai	Member
6.	Prof. K. Ramesh	Member
7.	Mr. K.B. Vishwanatha Reddy	Member
8.	Dr. Rajashekar. N.	Member
9.	Prof. Govindaiah	Member
10.	Prof. M.S. Talwar	Member
11.	Prof. D. Jeevan Kumar	Member
12.	Dr. Suresh V Nadagoudar	Member
13.	Prof. M.K. Sridhar	Member
14.	Prof. B.K. Muralidhara	Member
15.	Mrs. Lydia Samuel	Member
16.	Prof. Nathalia D' Souza	Member
17.	Mrs. Aruna Kumar. N.	Member
18.	Prof. M. Ramachandra Mohan	Member
19.	Prof. B.C. Prabhakar	Member
20.	Prof. D. Anusuya	Member
21.	Prof. A.S. Rayamane	Member
22.	Dr. Anjanappa. M.	Member
23.	Dr. Ramakrishnaiah	Member
24.	Prof. H.N. Ramesh	Member
25.	Prof. S.R. Ananthanarayana	Member
26.	Dr. K. Muni Reddy	Member
27.	Mr. Nagaraj Sherigar, Finance Officer	Member
28.	Prof. K.N. Ninge Gowda, Registrar (Eval.)	Member
29.	Prof. K.K. Seethamma, Registrar	Member - Secretary

At the outset, the Chairman welcomed all the members for the meeting and informed the members about the sad demise of Dr. N.H. Manjunath, Dean, Faculty of Science, BUB. The House observed two minutes silence as a mark of respect to the departed member. Then, the Chairman requested to take up the Agenda.

Item No.1: To consider the report submitted by the Local Inquiry Committee under the Chairpersonship of Prof. L. Gomathi Devi, Dept. of Chemistry, BUB.

Prof. L. Gomathi Devi, Chairperson of the LIC presented the report of the Local Inquiry Committee in respect of Bangalore City College of Education, Bangalore and Sri Venkateshwara College of Education, Bangalore. She informed the House that the Local Inquiry Committee visited the above two colleges on 02-08-2014 and checked all the infrastructure and requirements necessary as per NCTE norms. The Principal of Bangalore City College of Education, Bangalore produced all the records and list of staff approved by the University and registers viz., admission, attendance, aquittance, stock, scholarship disbursement registers before the Committee. She informed that the staff are not qualified with NET/SLET and the staff quarters have not been provided by the college. Further, the college has made 28 admissions during the year 2013-14 and 15 during 2012-13. The college has to equip the Library with required nos. of books as per NCTE norms. The College has got 49.2% weightage as per new tool.

In respect of Sri Venkateshwara College of Education, Bangalore the Principal had shown the 3rd floor of the building meant for B.Ed. course which is of 11,644 sq.ft. floor area. The college has appointed a Librarian. 100 students were admitted for 2013-14. However, none of the students were present during the visit of the Committee. We were told that students had gone for teaching practice classes. The Library needs to be upgraded with adequate no. of books as per NCTE norms.

The Committee has recommended for renewal of affiliation to the above two colleges and she requested the House to consider the report.

Dr. Rajesh E.B., informed the House that, his college (Cauvery College of Education) was made as centre for examination for the year 2012-13 for the students of Bangalore City College and the admission register of the said college which was produced at the time of examination is still in their custody and the college has not taken back the register. The Chairperson of the Local Inquiry Committee opined that admission register of 2012-13 shown to the Committee might be the other one. Dr. Ramesh. K, said that the floor area of Bangalore City College of Education is 4,868 sq.ft. x 3 floors and it is short of NCTE requirements. Hence, the affiliation cannot be given to Bangalore City College of Education. Prof. Jeevan Kumar and Prof. B.C. Prabhakar felt that the affiliation can be given as the College has secured 49.2%

weightage. However, the observations recorded by the Local Inquiry Committee and comments made in the Academic Council meeting may be communicated to the colleges.

Prof. M.K. Sridhar expressed that the Local Inquiry Committee tool was prepared after discussion in the Academic Council as well as Syndicate. Hence, we should respect the new tool and the recommendation of the Local Inquiry Committee may be accepted.

Resolution: After detailed discussion the House resolved to accept the recommendations of the Local Inquiry Committee.

Item No.2: To consider the re-inspection reports submitted by the Local Inquiry Committee under the Chairmanship of Prof. Govindaiah, Professor, Department of Sericulture, Bangalore University, Bangalore.

Prof. Govindaiah, Chairperson of the Local Inquiry Committee informed the House that the Committee under his Chairmanship re-inspected four colleges for enhancement of intake and renewal of affiliation. The Committee has recommended for enhancement of intake from 30 to 40 for BCA course at Global Institute of Management Science, Bangalore and for enhancement of intake to B.A.S.L.P. course from 20 to 30 at Samvaad College of Speech and Hearing, Bangalore. Further, the Commitee has recommended for renewal of affiliation to Mother Theresa College of Management and Science, Nelamangala as the college has good infrastructure and the college is situated in rural area. However, in respect of DBA Degree College, Bangalore the Committee visited the address given and there was a name board of the college but nobody was present there and it was told that the college does not exist in the said address. He further informed that, the Committee had made repeated efforts to call the college office land line numbers and Cell Phone numbers but invain. The Committee had to return without visiting the Institution.

Resolution: After detailed discussion, the House resolved to approve the recommendations of the Committee in respect of the following Colleges.

Sl. No.	Name of the College	Recommendations of the Committee
1.	Global Institute of Management Science, Rajarajeshwari Nagar, Bangalore-560 098	Recommended for enhancement of intake for B.C.A. course from 30 to 40 for the year 2014-15.
2.	Mother Theresa College of Management and Science, 94/1, Arasanakunte Danojipalya, Nelamangala, Bangalore-24	Recommended for renewal of affiliation for the year 2014-15 to B.B.M. and B.Com courses with existing sanctioned intake.

3.	Samvaad College of Speech and Hearing, # 18, 1st cross, 5th Main, Anandagiri Extension, Hebbal, Bangalore-24.	Recommended for enhancement of intake to B.A.S.L.P. course from 20 to 30 for the year 2014-15.

Further, the House resolved to recommend for disaffiliation of DBA Degree College, Rupena Agrahara Village, Begur Hobli, Hosur Road, Madiwala, Bangalore-68 as the same findings were made by the earlier Committee.

Item No.3: To consider the recommendations of the Faculty of Commerce Meeting held on 7-8-2014.

The Chairman requested the Dean, Faculty of Commerce, to present the recommendations of the Faculty of Commerce Meeting held on 7-8-2014.

The Dean presented the recommendations of the Faculty of Commerce Meeting held on 7-8-2014, with regard to introduction of Choice Based Credit System for P.G. courses in M.Com., M.F.A., M.I.B., M.T.A. and 5 years Integrated Course in M.T.A.

Resolution: The Academic Council resolved to approve the recommendations of the Faculty of Commerce Meeting held on 7-8-2014.

Item No.4: To consider the recommendations of the Faculty of Science Meeting held on 5-08-2014.

The Chairman requested the Dean, Faculty of Science, to present the recommendations of the Faculty of Science Meeting held on 5-08-2014.

The Dean, Faculty of Science informed the House that the Syllabus and Scheme of Examination were framed under Choice Based Credit System and requested to deliberate on the subject.

Resolution: The Academic Council resolved to approve the recommendations of the Faculty of Science Meeting held on 5-08-2014 and authorized the Dean, to incorporate the corrections if any, in the Syllabus and Scheme of Examinations.

Item No.5: To consider the recommendations of the Faculty of Arts Meeting held on 4-8-2014.

The Chairman requested the Dean, Faculty of Arts to present the recommendations of the Faculty of Arts Meeting held on 4-8-2014.

The Dean, Faculty of Arts informed the House that the Syllabus and Scheme of Examination were framed under Choice Based Credit System and requested to deliberate on the subject.

Resolution: The Academic Council resolved to approve the recommendations of the Faculty of Arts Meeting held on 4-8-2014 and authorized the Dean, to incorporate the corrections if any, in the Syllabus and Scheme of Examinations.

Item No.6: To consider the recommendations of the Faculty of Education Meeting held on 7-8-2014.

The Chairman requested the Dean, Faculty of Education, to present the recommendations of the Faculty of Education Meeting held on 7-8-2014.

The Dean, Faculty of Education informed the House that the Syllabus and Scheme of Examination were framed under the Choice Based Credit System and requested to deliberate on the subject.

Resolution; The Academic Council resolved to approve recommendations of the Faculty of Education Meeting held on 7-8-2014.

Item No.7: To consider modification to the existing regulation of B.Com. Degree Course from the academic year 2014-15.

The Dean, Faculty of Commerce informed the House that as per the request of the Chairman, Department of Commerce, has recommended the following modification to the

Regulation for admission to the B.Com. Degree Course from the academic year 2014-15 and requested the House to approve the same.

Existing	Modification sought
Candidates who have completed Two year Pre-University course of Karnataka State or its equivalent with Business Studies and Accountancy as two major subjects of study in both first and second year Pre-University are eligible for admission to this course.	Candidates who have completed Two years Pre-University course of Karnataka State or its equivalent with Business Studies and Accountancy as two major subjects of study at Pre-University level are eligible for admission to this course.

Resolution: ***The Academic Council resolved to approve the above mentioned modification to the Regulations with regard to eligibility for admission for B.Com. degree course to be effective from the academic year 2014-15.***

Item No.: 8 & 9: To consider promotion as Professor under UGC-Career Advancement Scheme for the Telugu/Kannada Language Teachers –reg.

The Vice-Chancellor informed the House that under UGC-Career Advancement Scheme with regard to promotion of Teachers under 19.4, the revised Regulations relating to Direct Recruitment and Career Advancement are as follows:

Statute :19.4: Besides the indexed publications documented by various discipline-specific databases, the University concerned shall draw through Committee(s) of subject experts and ISBN/ISSN experts (a) a comprehensive list of National/Regional level journals of quality in the concerned subject(s) and (b) a comprehensive list of vernacular language journals/ periodicals/ official publication volumes of language bodies and upload them on the University website which are to be updated periodically. At the time of assessing the quality of publications of the candidates during their appointments/promotions, the selection committees shall have to be provided with the above two lists which could be considered by the selection committees along with the other discipline-specific databases.

Accordingly, the Chairperson, Dept. of Telugu, had placed the matter before the Special Board of Studies and has submitted the proceedings of the Special Board of Studies in Telugu with regard to CAS promotions.

The Special Board of Studies has unanimously resolved to recommend to the University to consider the following as equivalent to books/journals without ISBN/ISSN Numbers for promotion of teachers to the post of Professors.

a) Registered Journals/books with Editorial Board.
b) Journals published by renowned researchers/academicians/philanthropists.
c) Journals published by reputed publishers over a period of ten years or prior to 2012.
d) Conference proceedings which are financially supported by the Universities/National bodies/Govt./UGC., etc.,
e) Articles published in Institutions like Sahitya Academi/ Folklore Society/DSERT/ Basavasmithi/CIL/Misimi/Shaitya Prathanam/Telugtejam/Kannada Sahitya Parishath/ University publications/ Telugu Vijnanasamithi/ Cultural Academics etc.,
f) Article published in journals which are cited in research thesis and referred journals etc.,
g) Journals/books recommend for UG/PG courses at University level.

JOURNALS: Papers published in Journals:

1. Misimi-samputi-19, sanchika-122, dec-2008
2. Telugu Tejam-samputi-1, sanchika-3, 4 Feb, March – 2009
3. Sahitya prasthanam, samputi-8, sankchika-43, June-2009

BOOKS: 1. Suvarna Karnataka male – 2007
2. Boji bheemanna sahityam jaatiya drukpatham – 2008
3. Acharya kolakaluri Enoch Sahityam paivimarsanam – 2009

Proceedings: 1. Telugu vani – Aidava akhila Bharata Telugu maha sabhala pratyeka sanchika – June - 2007

Resolution: ***After deliberation, the Academic Council resolved to approve proceedings of the Board of Studies in Telugu (PG) with regard to promotion as Professor under UGC – Career Advancement Scheme for Telugu Language Teachers.***

Under Any other Item:

The Dean, Faculty of Engineering informed the House about UVCE completing one hundred years of its existence in 2017. He requested the Hon'ble Vice-Chancellor to announce a suitable Developmental Model for this unique Institution.

The Vice-Chancellor in response to this, informed the House the details of his discussion with the Higher Education Minister and some distinguished Aluminies. He said that a Committee of Experts will have to be constituted to look into the Pros and Cons and suggest a suitable developmental Model suitable to a constituent College of the University, like U.V.C.E. This Committee will take into cognizance the views of all the stakeholders and the existing developmental proposals and will submit a comprehensive report to the University. Based on the recommendations of the report and the decision of this House, action will be taken for the developmental works of U.V.C.E.

The meeting concluded with thanks to the Chair.

REGISTRAR

VICE-CHANCELLOR

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BANGALORE UNIVERSITY B.Sc.(CBCS)
PHYSICS

Approved Syllabus effective from
Academic year 2016-17

BANGALORE UNIVERSITY
Scheme of Instruction & Examination for B.Sc. PHYSICS , CBCS

Serial Number	Paper Number	Teaching hours per week	Examination duration	Maximum marks		Maximum total marks	Credits
				Final exam	Internal Assessment		
01	PHY T101	4	3 hours	70	30	150	2
02	PHY P102	3	3 hours	35	15		1
03	PHY T201	4	3 hours	70	30	150	2
04	PHY P202	3	3 hours	35	15		1
05	PHY P301	4	3 hours	70	30	150	2
06	PHY T302	3	3 hours	35	15		1
07	PHY T401	4	3 hours	70	30	150	2
08	PHY P402	3	3 hours	35	15		1
09	PHY T501	3	3 hours	70	30	150	2
10	PHY P502	3	3 hours	35	15		1
11	PHY T503	3	3 hours	70	30	150	2
12	PHY P504	3	3 hours	35	15		1
13	PHY T601	3	3 hours	70	30	150	2
14	PHY P602	3	3hours	35	15		1
15	PHY T603	3	3 hours	70	30	150	2
16	PHY P604	3	3hours	35	15		1
Grand total						1200	16(T) 8(P)

Note-I:

- The paper number is a three digit number with ' **0** ' in the middle
- The digit to the left of ' **0** ' indicates the semester number
- Odd number to the right of ' **0** ' indicates a theory paper
- Even number to the right of ' **0** ' indicates a practical paper
- The prefix **T** indicates Theory paper and **P** indicates Practical

Note-II:

The marks distribution for the final practical examination is as follows:

1. Writing Principle / Statement/ Formula with explanation of symbols and units	05 Marks
2. Diagram/Circuit Diagram / Expected Graph	05 Marks
3. Setting up of the experiment + Tabular Columns + taking readings	10 Marks
4. Calculations (explicitly shown) + Graph	07 Marks
5. Accuracy of results with units	03 Marks
6. Class Records (to be valued at the time of practical examination)	05 Marks
Total for Practical Examination	**35 Marks**
Note : Wherever explicit setting up of experiments does not exist like in the case of spectral charts or pre – acquired data is involved(astrophysics or atmospheric experiments) , the marks for setting up of experiment may be provided for additional graphs and formulae	

Note-III:

- A minimum of **EIGHT** (8) experiments must be performed in each practical paper
- Experiments marked "Mandatory" should be performed necessarily

Syllabus for I Sem BSc, (Physics) Paper –I : Phy-T101:

MECHANICS – 1 , HEAT AND THERMODYNAMICS – 1

UNIT – I

- **MOTION** : Newton's Laws of Motion (Statement and illustration), Motion in a resistive medium; Drag force& Drag Coefficient, Drag force with v dependence (only vertical) and v^2 dependence (only vertical) – derivation for velocity and position- graphs with and without resistance, concept of terminal velocity

4 hours

- **FRICTION** : Static and Dynamic Friction – Friction as a self adjusting force, Coefficient of Static and dynamic friction; Expression for acceleration of a body moving along an inclined plane with and without friction, Free Body Diagrams for the following cases (i)Two masses connected by a string hanging over a frictionless pulley (ii)Two masses in contact and masses connected by strings (horizontal only) (iii)Two masses connected by a string passing over a frictionless pulley fixed at the edge of a horizontal table.

4 hours

- **PLANETARY & SATELLITE MOTION** : Motion along a curve - radial and transverse components of acceleration(derivation); Newton's law of gravitation (vector form only), Kepler's laws (statements only);Gravitational Field and Potential – relation between them; Field and Potential due to a solid sphere (derivation); Orbital and Escape Velocity (derivation), Satellite in circular orbit and applications; Geostationary and Geosynchronous orbits.

5 hours

UNIT – II

- **WORK & ENERGY :**Work done by a constant and variable force; Work energy theorem; Work and potential energy; examples of potential energy; Work done by gravitational force; Work done by a spring force; Conservative and non – conservative force; Conservation of mechanical energy **4 hours**
- **SYSTEM OF PARTICLES :**Centre of mass of rigid bodies – General expression; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Single stage Rocket

motion – Velocity & Acceleration with and without gravity; Elastic and inelastic collisions (only 2D)

4 hours

- **BLACK BODY RADIATION** : Black body radiation and its spectral energy distribution; Kirchhoff's law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law (Statements), Derivation of Planck's law – deduction of Wien's Law & Rayleigh – Jeans Law, Solar constant and its determination using Angstrom's Pyrheliometer; Estimation of the surface temperature of the sun

5 hours

UNIT – III

- **KINETIC THEORY OF GASES :**Basic assumptions of kinetic theory; Derivation of - deduction of perfect gas equation; Maxwell's law of distribution of velocity *(without derivation)*- deduction of most probable velocity, mean velocity and root mean square velocity; Derivation of expression for mean free path $\left(\lambda = \frac{3}{4\pi\sigma^2 n}; Maxwell's distribution law: \lambda = \frac{1}{\sqrt{2}\pi\sigma^2 n}\right)$; Degrees of freedom and principle of equipartition of energy; Derivation of , Specific heats of an ideal gas, atomicity of gases

6 hours

- **TRANSPORT PHENOMENA** :

Viscosity and thermal conduction in gases *(*with derivation) ;Relation between coefficient of viscosity and coefficient of thermal conductivity of a gas

2 hours

- **Real Gases :** Derivation of van der Waal's equation of state; Andrews experiments on Carbon dioxide; Derivation of the critical constants; Comparison of van der Waal's isotherms with Andrew's isotherms

5 hours

UNIT – IV

- **Basic Concepts and the Zeroth law of thermodynamics**

Macroscopic and microscopic descriptions of a system; Thermal Equilibrium - Zeroth Law of Thermodynamics; Concept of temperature; Thermodynamic equilibrium;

Thermodynamic coordinates - extensive and intensive; Equations of state; Various processes - PV indicator diagrams **3 hours**

- **First Law of Thermodynamics**

  The first law of Thermodynamics; Sign convention for heat and work; Derivation of equation of state $PV^{\gamma} = const$; Work done in an isothermal and adiabatic process for an ideal gas; Internal energy as a state function; Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process. **3 hours**

- **Second Law of Thermodynamics**

  Reversible and irreversible processes; Carnot Engine; Carnot Cycle and its efficiency (with derivation); Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence); Practical internal combustion engines - Otto and Diesel Cycles (qualitative treatment); Carnot theorem (proof); Refrigerator- Coefficient of performance

  4 hours

- **Entropy**

  The concept of entropy; Entropy of an ideal gas; Entropy - reversible process, Entropy - irreversible process; Entropy and the second law; Clausius inequality; Principle of increase of entropy; Entropy change in (i) adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process; TdS diagram of a Carnot cycle; Entropy and disorder

  3 hours

References:

1. Fundamentals of Physics- R.Resnik,D. Halliday and Walker; Wiley 6ed(**2001**)
2. Physics-Classical and Modern, FJ Keller, E Gettys and J J Skove, McGraw Hill Second Revised Edition(**1993**)
3. Classical Mechanics-K N Sreenivasa Rao, Universities Press- Orient Longman (**2003** ed)
4. Concepts of Physics Vol (1)-H C Verma, Bharathi Bhavan Publishers, **2004** Edition

5. University Physics- F W Sears, M W Zemansky & H D Young, Pearson Education First ed.(**2014**)

6. Mechanics- J C Upadhaya, Himalaya (**2014** ed)

7. Mechanics- Berkeley Physics Course Vol(1)- SI units CharlesKittel etal, McGrawHill Education (India) 2e (2011)

8. Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(**2010**)

9. Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (**2002)**

10. Newtonian Mechanics- A P French, Nelson & Sons UK, (**1971**)

11. Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education (India) 1ed (**1985**)

12. A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7th Revised edition **-2010**)

13. Waves & Oscillations, P K Mittal & Jai Dev Anand, Hari Anand Publications Pvt Ltd (2011ed)

14. Heat and Thermodynamics- M M Zemansky,McGrawHill Education (India) 8ed (**2011**)

15. Heat & Thermodynamics, MWZemansky & RHDittman, McGraw Hill Book company,Inc.US Seventh Revised edition(**1997**)

16. Heat and Thermodynamics- Brij Lal and N Subramanyam, SChand & Co, New Delhi -1985

17. Heat and Thermodynamics – D S Mathur, SChand & Co, New Delhi, 5th Edition(2004)

18. Heat, Thermodynamics & Stastical Mechanics, BrijLal & Subramanyam, S. Chand & Company,Delhi; (**2008** ed)

19. Thermodynamics & Statistical Physics, Sharma & Sarkar, Himalaya Publishing House, Third Edition(1991)

20. Thermodynamics, Kinetic theory & Statistical Thermodynamics, FWSears & GLSalinger, Narosa Publishing House (Third Edition **1998**)

21. Fundamentals of Classical Thermodynamics, Gordon J V Wylen & Richard E Sonntag, John

Wiley Eastern Limited; 4th ed (**1994**)

22. Thermal Physics, S C Garg, R M Bansal & C K Ghosh, McGrawHill Education (India) Second ed (**2013**)

PHYSICS – P102, PRACTICAL PHYSICS – I

1. Error Analysis – Data analysis techniques and graphing techniques to be learnt (**Mandatory**)
2. Atwood machine – with photogate
3. Determination of coefficients of static, kinetic and rolling frictions
4. Verification of principle of conservation of energy
5. Simple pendulum - dependence of T on amplitude
6. Determination of coefficient of viscosity by Stokes' method
7. Determination the Acceleration due to Gravity and Velocity for a freely falling body, using Digital Timing Techniques.
8. Work done by variable force
9. Interfacial tension by drop weight method
10. Thermal behavior of a torch filament
11. Specific heat by Newton's law of cooling
12. Verification of Newton's law of cooling and Stefan's law of radiation
13. Determination of Stefan's constant by emissivity method
14. Determination of Solar constant
15. Calibration of Thermistor for Temperature measurement
16. Calibration of thermocouple for Temperature measurement

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. B Saraf etc, - Physics through experiments, Vikas Publications (**2013**)
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London

4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002)**

5. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (**2007**) Revised Edition

Syllabus for II Sem BSc (Physics) Paper II-Phy-T201:

MECHANICS – 2 , HEAT AND THERMODYNAMICS – 2

UNIT – I

- **OSCILLATIONS :** SHM ; Differential equation of SHM and its solutions, Kinetic and Potential energy, Simple and compound pendulum; oscillations of two masses connected by a spring; damped oscillations – over damped, under damped and un-damped oscillations; forced oscillations - concept of resonance; Coupled Oscillators - in phase and out of phase oscillations- energy transfer. **6 hours**
- **ELASTICITY**: Hooke's law, Stress – Strain diagram, definitions of three elastic moduli; Relationship between three elastic constants (derivation); Poisson's ratio; Work done in stretching a wire; Bending of beams; Bending moment, Theory of single cantilever, Couple per unit twist, Torsional oscillations.
  7 hours

UNIT – II

- **Thermodynamic potentials :** Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell's thermodynamic relations (using Thermodynamic potentials) and their significance; TdS relations; Energy equations and Heat Capacity equations; Third law of thermodynamics (Nernst Heat theorem)
  4 hours
- **Phase transitions of the first order :** Melting, vaporization and sublimation; Condition of equilibrium of phases in terms of Gibbs potential;Clausius-Clapeyron equation - elevation of boiling point, depression of freezing point; Equilibrium between phases - triple point **3 hours**
- **Low Temperature Physics :** Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment, Joule Thomson

Coefficient, inversion temperature (ii) Adiabatic demagnetization - working and theory **4 hours**

- **Liquefaction of gases :** Regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)

2 hours

UNIT – III

- **FRAMES OF REFERENCE :** Inertial and Non inertial frames of reference - Importance of Inertial frame, Linearly accelerated frames, Concept of frame dependent forces; Galilean relativity - Transformation of Position, Distance/Length, Velocity (Non-relativistic velocity addition theorem), Acceleration; Principle of Invariance, Michelson – Morley Experiment, Search for ether

5 hours

- **SPECIAL THEORY OF RELATIVITY :** Postulates of the special theory of relativity; Lorentz Transformations – Length Contraction, Time Dilation – twin paradox, Velocity Addition Theorem; Variation of mass with velocity; Mass – Energy equivalence; Relativistic momentum and kinetic energy

8 hours

UNIT – IV

- **MOMENT OF INERTIA** : Review of rotational motion of Rigid bodies; Kinetic energy of rotation-Moment of Inertia of a body; Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case); Calculation of moment of inertia of a disk, annular ring, solid sphere and rectangular bar; Conservation of angular momentum with illustrations.

9 hours

- **WAVES :** Wave Equation, Speed of transverse waves on a uniform string; Speed of longitudinal waves in a fluid; Group velocity and Phase velocity – relation between

them; **4 hours**

References:

1. **References:**
2. Fundamentals of Physics- R.Resnik,D. Halliday and Walker; Wiley 6ed(**2001**)
3. Physics-Classical and Modern, FJ Keller, E Gettys and J J Skove, McGraw Hill Second Revised Edition(**1993**)
4. Classical Mechanics-K N Sreenivasa Rao, Universities Press- Orient Longman (**2003** ed)
5. Concepts of Physics Vol (1)-H C Verma, Bharathi Bhavan Publishers, **2004** Edition
6. University Physics- F W Sears, M W Zemansky & H D Young, Pearson Education First ed.(**2014**)
7. Mechanics- J C Upadhaya, Himalaya (**2014** ed)
8. Mechanics- Berkeley Physics Course Vol(1)- SI units CharlesKittel etal, McGrawHill Education (India) 2e (2011)
9. Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(**2010**)
10. Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (**2002)**
11. Newtonian Mechanics- A P French, Nelson & Sons UK, (**1971**)
12. Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education (India) 1ed (**1985**)
13. A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7th Revised edition -**2010**)
14. Waves & Oscillations, P K Mittal & Jai Dev Anand, Hari Anand Publications Pvt Ltd (2011ed)
15. Heat and Thermodynamics- M M Zemansky,McGrawHill Education (India) 8ed (**2011**)
16. Heat & Thermodynamics, MWZemansky & RHDittman, McGraw Hill Book company,Inc.US

Seventh Revised edition(**1997**)

17. Heat and Thermodynamics- Brij Lal and N Subramanyam, SChand & Co, New Delhi -1985
18. Heat and Thermodynamics – D S Mathur, SChand & Co, New Delhi, 5th Edition(2004)
19. Heat, Thermodynamics & Stastical Mechanics, BrijLal & Subramanyam, S. Chand & Company,Delhi; (**2008** ed)
20. Thermodynamics & Statistical Physics, Sharma & Sarkar, Himalaya Publishing House, Third Edition(1991)
21. Thermodynamics, Kinetic theory & Statistical Thermodynamics, FWSears & GLSalinger, Narosa Publishing House (Third Edition **1998**)
22. Fundamentals of Classical Thermodynamics, Gordon J V Wylen & Richard E Sonntag, John Wiley Eastern Limited; 4th ed (**1994**)
23. Thermal Physics, S C Garg, R M Bansal & C K Ghosh, McGrawHill Education (India) Second ed (**2013**)
24. Physics of Waves, University Leadership Project, Prasaranga, Bangalore University
25. Perspectives of Modern Physics, Arthur Beiser, Mc- Graw Hill;
26. Introduction to Special Theory of Relativity, Rober Resnick, John Wiley and Sons First Edition
27. Special Relativity, A P French, MIT, w.w.Nortan and CompanyFirst Ed (**1968)**
28. Concepts of Modern physics McGraw hill Education(India) Pvt Ltd;6th ed **(2000)**

PHYSICS – P202, PRACTICAL PHYSICS – II

1. Torsional pendulum – to determine C and Rigidity modulus
2. Bar pendulum – determination of g
3. Spring mass- (a) static case to determine 'k'
   (b) dynamic case to determine 'k'
   (c) 'k' as a function of L of spring
4. Rigid pendulum – T and decay of amplitude
5. Coupled oscillator – string coupled with change of tension
6. Rolling dumb bell - on parallel inclined rails
7. Verification of parallel and perpendicular axis theorem
8. Searle's double bar
9. Cantilever of negligible mass to find Young's modulus
10. q- by Stretching
11. q by uniform bending
12. q by single cantilever
13. q by Koenig's method
14. n by dynamic method
15. Fly wheel
16. Verification of Clausius-Clapeyron equation using pressure cooker
17. Thermal conductivity of a bad conductor by Lee's and Charlton's method
18. Thermal conductivity of rubber
19. Determination of thermal conductivity of a good conductor by Angstrom method / Searle's method

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. B Saraf etc, - Physics through experiments, Vikas Publications
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002

5. BSC, Practical Physics, C L Arora, S Chand & Co, New Delhi, 2007 Revised Edition

Syllabus for III Sem BSc (Physics) Paper III-Phy-T301:

ELECTRICITY and MAGNETISM

UNIT – I

DC CIRCUIT ANALYSIS : Concept of Voltage and Current Sources, Kirchhoff's Current Law, Kirchhoff's Voltage Law (statements). Principle of Duality (voltage and current source equivalents). Thevenin's Theorem (statement and proof), Superposition Theorem(statement and proof), Norton's Theorem (Statement and explanation). Reciprocity Theorem. Maximum Power Transfer Theorem (statement and proof).

8 hours

Transient currents : Self inductance – definition, explanation, expression $L = \frac{\mu N^2 A}{l}$; Magnetic field energy stored in an inductor; Growth and decay of charge in series RC circuit, Growth and decay of current in series LR circuit, Decay of charge in series LCR circuit - Damped, under-damped and over-damped conditions

5 hours

UNIT – II

Magnetic Field and Forces : Force on a moving charge in a magnetic field, Lorentz force and definition of **B**, force on a current carrying conductor in uniform magnetic field, Force between parallel conductors; Definition of ampere;

Biot – Savart's law, Magnetic field due to a straight current carrying conductor (Derivation for Finite/Infinite Length, Amperes swimming rule, Right hand palm rule), Magnetic field of a circular loop; Force and torque on a circular current loop in a magnetic field, magnetic dipole moment, Field on the axis of a solenoid (derivation and explanation), Principle and theory of a moving coil BG, Concept of dead beat galvanometer, determination of high resistance by leakage, theory of HTG, Ampere's Circuital law (statement), Application of Ampere's law to straight wire, solenoid and toroid

13 hours

UNIT III

Scalar and vector fields : Gradient of a scalar function (use of del operator), Divergence and Curl product rules (explanation with geometrical representation), Line, surface and volume integrals

(explanation with examples), Fundamental theorem for divergence and curl (statements only).

3 hours

ELECTROMAGNETIC WAVES : Equation of Continuity, Displacement Current, Maxwell's equations in differential form (Derivation and physical significance), Derivation of wave equation (for one dimension), Velocity of em waves in free space and isotropic dielectric medium(derivation), Relation between refractive index and permittivity (qualitatively), Transverse nature of Plane em waves, , Poynting Vector, Energy density in electromagnetic field, Momentum and Pressure of em waves (derivation), Electromagnetic waves in a conducting medium – skin effect and skin depth

10 hours

UNIT IV

ALTERNATING CURRENT : rms and average value of ac – definition and expressions, Representation of sinusoids by complex numbers (brief explanation), response of LR, CR and LCR series circuit to sinusoidal voltage – j operator method, series and parallel resonant (LR parallel C) circuits (mention condition for resonance with expressions for impedance and current), expression for Q factor, band width, AC bridge - Maxwell bridge (derivation of condition for balance , determination of self-inductance of a coil).

6 hours

THERMOELECTRICITY : Seebeck effect (brief explanation, experiment and temperature dependence), Thermoelectric series, Neutral temperature, Laws of thermoelectricity (qualitative), Peltier effect, Peltier coefficient (qualitative analysis), Thomson effect, Thomson coefficient (qualitative analysis), Theory of thermoelectric circuits using thermodynamics (Application of thermodynamics to a thermocouple and connected relations with derivation), Thermoelectric diagrams and uses (in finding the Seebeck Coefficients, Peltier coefficient, Thomson coefficient, total emf of a thermocouple, neutral temperature) Applications of thermoelectricity - Boys' Radio-micrometer, thermopile and thermoelectric pyrometer (brief explanation with experimental setup).

7 hours

References:

1. Electricity and magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993

2. Principles of Electronics by VK Mehta and Rohit Mehta, SChand & Company, Eleventh Edition, **2008**

3. Feynman Lecture series, VolII, RPFeynnman et al, Narosa Publishing House, New Delhi

4. Electricity & Magnetism, NSKhare & SSSrivastava, AtmaRam & Sons, New Delhi

5. Electricity & Magnetism, DLSehgal, KLChopra, NKSehgal, SChand & Co, Sixth Edition, (**1988**)

6. Electricity & Electronics, DCTayal, Himalaya Publishing House, Sixth Edition(**1988**)

7. Basic Electronics & Linear Circuits, NN Bhargava, DC Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint, (**1999**)

8. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (**1994**)

9. Introduction to Electrodynamics by DJ Griffiths Pearson Education (**2015**)

10. Electromagnetism by BB Laud 2ed

11. Electrical Networks, Theraja 3rd revised edition

PHYSICS – P302, PRACTICAL PHYSICS – III

1. To find L and C by equal voltage method

2. Energy consumption in an electrical circuit - to find power factor

3. Resonance in LCR series circuit

4. Resonance in LCR parallel circuit

5. Mirror galvanometer- figure of merit

6. High resistance by leakage using BG

7. Thermoelectric circuit - find Seebeck coefficients

8. Verification of Law of intermediate metals

9. Study of thermo emf as a heat pump

10. Load regulation of constant current source

11. Black box - identify & measure R, L and C

12. Verification of Thevenin's theorem

13. Verification of Superposition theorem

14. Verification of maximum power transfer theorem

15. Maxwell's impedance bridge

16. Desauty's bridge

17. Anderson's bridge

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. Physics through experiments, BSaraf etc,Vikas Publications **1987**
2. Advanced practical physics, Chauhan & Singh, Pragathi Publications 1ed
3. Practical Physics, DChattopadhyaya et al, Central Publications
4. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, **2002**
5. Practical Physics, D C Tayal **2002**

Syllabus for IV Sem BSc (Physics) Paper IV - PhyT401:

OPTICS and FOURIER SERIES

UNIT I

WAVE OPTICS: Huygen's wave theory of light; Huygen's principle, construction Huygen's wave front, Laws of reflection and refraction using spherical wave for at a plane surface (derivation of image distance = object distance using Huygen's construction, derivation of Snells law).

3 hours

INTERFERENCE :

Coherent sources and their production; Conditions for observing interference (mention); Conditions for

constructive and destructive interference (mention)

1 hour

Coherent sources by division of wave front

Biprism-theory and working, experiment to determine wavelength; Effect of thin film in the path of one of the beams; Calculation of thickness of the **5 hours**

Coherent sources by division of amplitude:

Interference at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Only reflected System). Determination of Refractive index of a liquid **4 Hours**

Unit - II

Diffraction - Fresnel diffraction

Concept of Fresnel's half period zones; Theory of rectilinear propagation; Fresnel diffraction, Construction and working of Zone plate; Comparison of Zone plate with lens; Cylindrical Wavefront (Half period strips – qualitative), Theory of diffraction at a straightedge **7 hours**

Fraunhoffer diffraction

Theory of single slit diffraction; Theory of grating - normal and oblique incidence - Experimental determination of wavelength; Discussion of Dispersive power; Resolving power, Rayleigh's criterion; Expression for resolving power of grating and telescope; Comparison of prism and grating spectra **6 Hours**

UNIT III

Polarization

Review of plane polarized light and method of production; Double refraction at crystals; Huygens' explanation of double refraction; Theory of retarding plates - Quarter wave plates and Half wave plates; Theory of superposition of two plane polarized waves with perpendicular vibrations, Production and detection of linearly , elliptically and circularly polarized light; Optical activity - Fresnel's explanation, Laurent's half shade polarimeter. **6 Hours**

Lasers

Introduction; Spontaneous and stimulated emission; Einstein's coefficients and optical amplification; Population inversion; Main components of a laser; Lasing action; Ruby Laser - construction and working - energy level diagram; He-Ne Laser - construction and working - energy level diagram;
Spatial Coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density

7 hours

UNIT IV

Fourier Series: Periodic functions**.** Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only)**.** Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients**.** Complex representation of Fourier series {Example : Fourier Series for

(i) $f(x) = e^x if -\pi < x < \pi$

(ii) $f(x) = \begin{cases} -1 - \pi \leq x \leq 0 \\ 10 \leq x \leq \pi \end{cases}$

(iii) $f(x) = x^2 \in the interval [-1, +1]$ }

Expansion of functions with arbitrary period**.**
(Concept of change of scale; Fourier Series for Periodic Rectangular Wave; Half – Wave rectifier; Trapezoidal wave :

$$f(x) = \begin{cases} x, 0 \leq x \leq 1 \\ 1, 1 \leq x \leq 2 \\ 3 - x, 2 \leq x \leq 3 \end{cases}$$

)Application to Square wave, triangular Wave and Saw Tooth Wave (superposition of first three components to be shown graphically) **.** **9 hours**

Optical Fibres

Optical fiber-principle, description and classification; Why glass fibers? Coherent bundle; Numerical aperture of fiber; Attenuation in optical fibers - limit Multimode optical fibers; Ray dispersion in multi-mode step index fibers; **4 hours**

References:

1. Optics, Ajoy Ghatak, Tata Mc Graw Hill, 4th Edition

2. Introduction to Modern Optics, Ajoy Ghatak, Tata McGraw Hill Publications (**2009**)

3. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (**1994)**

4. A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan/Premium Publishing Corp (**1978**)

5. Jenkins and White, Optics, McGraw Hill Education India Pvt Ltd 4th ed(**2011**)

6. Optics, Brij Lal and Subramaniam, SChand & Company, 22nd Edition, (**1994**)

7. Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition, (**1996**)

8. An Introductions to LASERS-Theory & Applications, M N Avadhanulu, S Chand & Co, (**2001**)

9. Introduction to Fibre Optics, Ajoy Ghatak & K Thyagarajan, Cambridge University Press, First Edition Reprint,(**2002**)

10. Optical Fibre Communications, Gerd Keiser, McGraw Hill, 3rd Edition, (**2000**)

10. Fibre Optic Communication, DCAgarwal, Wheeler Publications, Second Edition Reprint,(**1996**)

11. Optics, Klein and Furtak, Wiley Publications Pvt Ltd 2ed (**2011**)

12. B B Laud, Lasers and Non-Linear optics. NewAge International Pvt Ltd Publishers (**2011**)

13. Physics of Waves, University Leadership Project, Prasaranga, Bangalore University(1ed **1981**)

14. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley 10th ed(**2003**)

15. Mathematical Physics, B D Gupta, Vikas Publshing House, 4th ed (**2016**)

PHYSICS – P402, PRACTICAL PHYSICS – IV

1. Verification of Brewster's law
2. Refractive index of a liquid by parallax method
3. Focal length of combination of lenses separated by a distance
4. Biprism – determination of wavelength of light
5. Air wedge – determination of thickness of object
6. Newton's rings – determination of radius of curvature of lens surface
7. Newton's rings – determination of refractive index of a liquid.
8. Diffraction grating in minimum deviation position
9. Diffraction grating in normal incidence position
10. Resolving power of telescope
11. Resolving power of a grating
12. Diffraction at straight edge
13. Polarimeter – determination of specific rotation of a solution
14. Diffraction of LASER at a wire
15. Measurement of numerical aperture of an optical fibre.
16. Fraunhoffer diffraction of LASER at single slit
17. Diffraction of LASER at graduations of a metal scale

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, **2002**

2. Practical Physics, Experiments with He-Ne laser, R S Sirohi 2nd ed

3. Advanced Practical Physics, Worsnop & Flint Asia Pub.(1979)

4. BSc, Practical Physics, C L Arora, S Chand & Company, New Delhi, Revised Edition, **2007**

Syllabus for V Sem. B.Sc. (Physics) Paper V – Phy T501:

STATISTICAL PHYSICS, QUANTUM MECHANICS – I, ATMOSPHERIC PHYSICS AND NANOMATERIALS

UNIT I : STATISTICAL PHYSICS (15 HOURS)

Specification of state of the system, Macro state, Micro State, Phase Space, Stirling's Approximation, Thermodynamic Probability and its calculation (Description of each with an example); Entropy and Thermodynamic probability ($S = kln\Omega$). Basic postulates of Statistical Physics ; Ensemble (Micro – canonical, canonical and grand canonical ensembles)

2 hours

Maxwell – Boltzmann Statistics : Maxwell – Boltzmann Distribution function (Derivation of $n_i = \frac{g_i}{e^{\alpha+\beta E_i}}$, Energy distribution function $f(E_i) = \frac{n_i}{g_i}$); Maxwell – Boltzmann law of velocity distribution (mention- most probable velocity, average velocity, rms velocity) Limitations of M – B statistics **3 hours**

Bose – Einstein Statistics : B-E distribution function (Derivation of $n_i = \frac{g_i}{e^{\alpha+\beta E_i - 1}}$) Bose-Einstein condensation properties of liquid He (qualitative) [Mention of expression of Bose Temperature T_B– Concept BE Condensation –variation of N_o (number of particles in Zero energy state) and N_e (number of particles in non-Zero energy state) with temperature- BE condensation properties of Liquid He^4 (Qualitative description)]

Radiation as photon gas, Bose's derivation of Planck's law, Rayleigh-Jeans law, Wein's law ; Specific Heat capacity of metals [Einstein's theory of specific heat capacity of solids – [Derivation of the equation where $\theta = h\nu/k$] **5 hours**

Fermi – Dirac Statistics :

Fermi-Dirac distribution function; Fermi sphere and Fermi energy, Fermi gas; Electronic Specific heat Capacity in metals (Mention of the contribution to specific heat capacity from free electrons)

Comparison of Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac distribution functions

5 hours

UNIT II : QUANTUM MECHANICS – I

Failure of Classical Physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photoelectric effect, Compton effect and specific heat of solids, Planck's quantum theory, Explanation of the above effects on the basis of quantum mechanics

[Experimental observation, failure of classical theory, quantum mechanical explanation, Photoelectric effect -Einstein's explanation, Compton Effect – mention of expression for wavelength shift (no derivation), Specific heat of solids -Einstein's and Debye's explanation of specific heat (qualitative). Stability of atom and atomic spectra, Black body radiation [Mention of Planck's equation, arrive at Wien's and Rayleigh-Jean's equation for energy distribution from Planck's equation]. **5 hours**

de Broglie's hypothesis of matter waves (λ in terms of momentum, energy, temperature for monoatomic gas molecules); Thomson's experiment; Davisson and Germer's experiment – normal incidence method; Concept of wave packet, Group velocity and particle velocity (relation between group velocity and particle velocity) Heisenberg's uncertainty principle - different forms; Gamma ray microscope experiment; Application to Non – existence of electron in nucleus **10 hours**

UNIT III : ATMOSPHERIC PHYSICS

Fixed gases and variable gases; Temperature structure of the atmosphere; Hydrostatic balance, Variation of pressure with altitude, scale height; Relative and Absolute humidity **4 hours**

Beer's law (derivation); Global energy balance for earth – atmosphere system, Greenhouse effect; Atmosphere dynamics –Accelerated rotational frames of reference – Centripetal and Coriolis force (derivation), Gravity and pressure gradient forces (with derivation), Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks **6 hours**

NANOMATERIALS

Nanomaterials – Introduction, classification – (0D, 1D, 2D). Quantum dots, nanowires and nanofilms, Multilayered materials- Fullerene, Carbon Nano Tube (CNT), Graphene (Mention of structures and properties); Synthesis techniques (Top down- Explanation of Milling & bottom up - Sol gel process). Characterisation techniques- (brief description of SEM, TEM, AFM).

Electron confinement (0D, 1D, 2D- energy levels as a particle in a box); Size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Distinct properties of nano materials (Mention- optical, electrical, mechanical and magnetic properties);

Mention of applications: (Fuel cells, catalysis, phosphors for HD TV, next generation computer chips, elimination of pollutants, sensors) **5 hours**

References :

1. Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (**2004**)
2. Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education ,(**2005**)
3. Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (**2000**)
4. Principles of Quantum Mechanics, ***Ghatak and Lokanathan***, Macmillan, (**2004**)
5. Statistical Mechanics, An Introduction, **Evelyn Guha**, Narosa (**2008**)
6. Statistical Mechanics, ***R.K.Pathria***, 2nd edition, Pergamon Press (**1972**)
7. Statistical and Thermal physics, ***F.Reif***, McGraw Hill International(**1985**)
8. Statistical Mechanics, ***K.Huang***, Wiley Eastern Limited, New Delhi (**1975**)
9. Basic of Atmospheric Physics, A Chandrasekar, PHI Learning Private Limited (EEE)
10. Weather, climate and atmosphere by Siddartha.
11. Atmospheric Science by John M Wallace and Peter V Hobbs, Elsevier Publications (**2006**).
12. Introduction to Atmospheric Science by Turberick &Lutzens,Elsevier Publications
13. Nano materials, A K Bandopadhyay. New Age International Pvt Ltd Publishers (**2007**)
14. Nanocrystals, C. N. Rao, P. John Thomas.
15. Nanotubes and wires, C. N. Rao, A. Govindaraj.

PHYSICS – P502, PRACTICAL PHYSICS – V(A)

1. Applications of CRO in the (a) study of Lissajous figures (b) calculation of rms voltage (c) calculation of frequency of AC. **(Mandatory)**
2. Monte Carlo experiment & error analysis
3. Verification of Maxwell's distribution of velocity
4. Maxwellian distribution of velocities for electron using EZ81vacuum diode
5. Dice experiment – to study statistical nature of results
6. Study of statistical distribution on nuclear disintegration data (using GM counter as a black box)
7. Characteristics of a photo cell-determination of stopping potential.

8. Determination of Planck's constant.
9. Characteristics and spectral response (selenium photocell)
10. Determination of particle size using XRD Scherer's formula.
11. Temperature of atmospheric air - by using Thermograph (Bimetallic type)- Plotting the graph of temperature Vs time.
12. Relative humidity using hair hygrometer
13. Estimation of relative humidity using wet and dry bulb thermometer
14. Wind speed and direction by Hand held anemometer and wind wane
15. Estimation of height from the given pressure data
16. Regulated power supply (using zener diode).
17. Determination of transistor h-parameters.
18. Frequency response of a CE amplifier.
19. Transistor as a switch and active device.
20. Construction of RFO or AFO - using transistor
21. Emitter follower

Note: A minimum of EIGHT experiments must be performed.

References :

1. Worsnop and Flint , Advanced practical physics for students, Asia Pub.(**1979**)
2. Singh and Chauhan, Advanced practical physics, 2 vols., Pragati prakashan, (**1976**)
3. Misra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
4. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
5. Ramalingom & Raghuopalan : A Lab. Course in Electronics
6. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)

Syllabus for V Sem. B.Sc. (Physics) Paper VI – Phy T503:

ASTROPHYSICS, SOLID STATE PHYSICS AND SEMICONDUCTOR PHYSICS

UNIT-I : ASTROPHYSICS (15 hours)

Parallax and distance: Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

Luminosity of stars: Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude - distance - modulus relationship. Distinction between visual and bolometric magnitudes, Radius of a star. **3 hours**

Stellar classification: Pickering classification and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics.

Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of Virial theorem.

Surface or effective temperature and color of a star : Wien's displacement law. Expressions for - average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star. Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star.

7 hours

Evolution of stars: Stages of star formation (GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion- its types, Chandrasekhar limit. Event Horizon,Singularity,Schwarzchildradius(qualitative)

5Hours

Unit-2: Solid State Physics (15 hours)

Crystal systems and X-rays: Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. **6 hours**

Free electron theory of metals : Electrical conductivity- classical theory (Drude-Lorentz model); Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons (with derivation); Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero(derivation). Hall Effect in metals

6 Hours

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect, Type I and type II superconductors– BCS Theory (qualitative); Applications - SQUIDs. **3 hours**

Unit-3: Semiconductor Physics

Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration(derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – mention of expressions for carrier concentrations and conductivity – impurity states in energy band diagram and the Fermi level.

Formation of P-N junction, depletion region, Biased P-N junction, variation of width of the depletion region, drift and diffusion current –expression for diode current.

6 hours

Special Diodes: Zener diode – characteristics and its use as a voltage regulator.

Photo diodes, Solar cells and LED (principle, working and applications). **4 hours**

Transistors: Transistor action, Characteristics (CE mode), DC Biasing , Load line analysis (Operating Point, Fixed Bias – Forward bias of Base – Emitter, collector – emitter loop, transistor saturation, Load line analysis ; Voltage divider bias – Transistor saturation, Load line analysis)

Transistor as an amplifier(CE mode); . H-parameters **5 hours**

References :

1. Astronomy : Fundamentals and Frontiers – **Jastrow & Thompson,** John Wileyand Sons 4th Revised ed (**1984**)
2. Chandrashekhar and his limit – **G. Venkataraman,** University press, reprint (**1997**)
3. An introduction to Astrophysics – **Baidyanath Basu,** PHI 2nd ed (**2010**)
4. Astrophysics Concepts, ***M. Herwit***: John Wiley, (**1990**)**.**
5. Astrophysics. ***Krishnaswamy*** (ed)New Age Publishers,(**1996**)
6. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
7. Solid State Physics**- A J Dekker**, MacMillan India Ltd, (**2000**)
8. Elementary Solid State Physic, **J P Srivastava**,PHI,(**2008**)
9. Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
10. Solid State Physics**-F W Ashcroft and A D Mermin-**Saunders College (**1976**)
11. Solid State Physics**-S O Pillai-**New Age Int. Publishers (**2001**)

PHYSICS – 504, PRACTICAL PHYSICS – V(B)

1. Parallax Method – Distance of objects using trigonometric parallax.
2. HR Diagram & the physiMisra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
3. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
4. Ramalingom & Raghuopalan : A Lab. Course in Electronics
5. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)cal properties of stars.
6. Analysis of stellar spectra.
7. Determination of temperature of a star (artificial) using filters.
8. Analysis of sunspot photographs & solar rotation period.
9. Mass luminosity curve – Estimation of mass of a star.
10. Mass of binary stars.
11. Resistivity of a material by four probe method.
12. Determination of Lorentz Number
13. Semiconductor temperature sensor.
14. Temperature coefficient of resistance and energy gap of thermistor.
15. LED characteristics and spectral response.
16. LDR characteristics – dark resistance – saturation resistance.

17. Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
18. Study of Hall effect in a metal.
19. Characteristics of LASER diode.
20. Spectral response of a photodiode and its I – V characteristics.
21. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
22. Determination of Fermi energy of a metal.
23. Determination of thermal conductivity of a metal by Forbe's method.
24. Measurement of heat capacity of metals.

Note: A minimum of EIGHT experiments must be performed.

References :

1. IGNOU : Practical Physics Manual IGNOU publications
2. Saraf : Experiment in Physics Vikas publicatios
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics.
5. Misra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
7. Ramalingom & Raghuopalan : A Lab. Course in Electronics
8. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)

Syllabus for VI Sem. B.Sc. (Physics) Paper VII – Phy T601:

ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

UNIT I : ATOMIC AND MOLECULAR PHYSICS (15 HOURS)

Vector Model of the Atom

Review of Bohr's theory of hydrogen atom, Sommerfeld's modification of the Bohr atomic model (qualitative). Spatial quantization and spinning electron. Different quantum numbers associated with the vector atom model, Spectral terms and their notations, Selection rules, Coupling schemes(*l*-s and j-j coupling in multi electron systems), Pauli's Exclusion Principle, Expression for maximum number of electrons in an orbit. Spectra of alkali elements (sodium D-line), Larmor precession, Bohr magneton, Stern-Gerlach Experiment . Zeeman Effect- Experimental study, theory of normal and anomalous Zeeman effect based on quantum theory. **10 hours**

Molecular Physics: Pure rotational motion, Spectrum and selection rules; Vibrational motion, vibrational spectrum and selection rules; Rotation-Vibration spectrum; Scattering of light-Tyndall scattering, Rayleigh scattering and Raman scattering. Experimental study of Raman effect, Quantum theory of Raman effect - Applications . **5 hours**

UNIT II : RADIOACTIVE DECAY, DETECTORS AND ACCELERATORS (15 HOURS)

Alpha particle scattering : Rutherford's theory of alpha scattering (assuming the path to be hyperbolic) **2 hours**

Radioactive Decay : Laws of radioactive decay, half – life, mean life, decay constant; theory of successive disintegration (expression for number of atoms of n^{th} element in the chain – Bateman equations); radioactive equilibrium (secular and transient - cases of long lived parent, short lived parent, daughter and parent of nearly equal half – life).

3 hours

Alpha decay : Range and energy, Geiger- Nuttal law , Characteristics of alpha spectrum, Gamow's theory of alpha decay [Barrier height, tunneling effect, $\lambda = Pf$ f is the frequency of collision of nucleon with the potential barrier; P is the probability of transmission through the barrier); Barrier

penetrability factor (p)$e^{-\sqrt{\frac{2\mu}{\hbar^2}}\int_{r_0}^{r_i}\sqrt{V(r)-E}dr}$ (no derivation)]

Derivation of Q-value-of alpha decay; Exact energy of alpha particle emitted

3 hours

Beta decay : Types of beta decay (electron, positron decay and electron capture) Characteristics of beta spectrum and Pauli's neutrino hypothesis **2 hours**

Detectors : Variation of ionization current with applied voltage in a gas counter, Proportional counter, GM Counter (Construction, working, characteristics, efficiency and quenching)

3 hours

Particle accelerators : Linear accelerator, Cyclotron, Betatron **2 hours**

UNIT III : NUCLEAR REACTIONS AND PARTICLE PHYSICS

NUCLEAR REACTIONS : Types of reactions, Conservation laws in nuclear reactions with examples, derivation of Q – value for reactions using the energy – momentum conservation, exoergic and endoergic reactions, threshold energy , reaction rate, reaction cross – section, concept of direct and compound reactions, resonance reaction; Power reactors

8 hours

ELEMENTARY PARTICLES : Classification of elementary particles, Fundamental interactions (Gravitational, Electromagnetic, Weak, strong – range, relative strength, particle interactions for each);

Symmetries and Conservation Laws (momentum, energy, charge, parity, lepton number, baryon number, isospin, strangeness and charm); Concept of Quark Model, Color quantum number and gluons; **7 hours**

Reference Books:

1. Concepts of Modern Physics, Beiser 3rd edition, Student edition, New Delhi (1981).
2. Introduction to Atomic Physics – H.E. White
3. Introduction to Modern Physics – H.S. Mani, G.K. Mehta-West Press (1989).

4. Principles of Modern Physics, A.P. French, John Wiley, London (1958).
5. Modern Physics - S.N. Ghoshal, Part 1 and 2 S. Chand and Company (1996).
6. Physics of the Atom, Wehr et. al. McGraw Hill
7. Atomic and Nuclear Physics, S. N. Ghoshal: Vol. II. (2000).
8. Alpha, beta and gamma spectroscopy, K. Seighbahn: Vol. I and II, John Wiley (1967)
9. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
10. Nuclear Physics, D C Tayal, Himalaya Publishing House, 5th Edition
11. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
12. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
13. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons 2nd revised ed (**2008**)
14. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi(**2008**)
15. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, (2004).
16. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, (**2000**).
17. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., (**1991**)

PHYSICS – 602, PRACTICAL PHYSICS – VI(A)

1. Study of hydrogen spectrum.
2. Sommerfeld's fine structure constant determination.
3. Determination of e/m by Thomson's method.
4. Characteristics of GM counter.
5. Determination of half-life of K^{40}.
6. Millikan's Oil drop experiment
7. Analysis of band spectrum of PN molecule.
8. Analysis of rotational spectrum of nitrogen.
9. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
10. Absorption spectrum of $KMnO_4$.
11. B – H Curve using Oscilloscope
12. Verification of Curie – Weiss Law
13. To verify and design AND, OR, NOT and XOR gates using NAND gates
14. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.
15. Digital Half-adder & Full-adder circuits using logic gate ICs.

16. Half Subtractor & Full Subtractor, using logic gate ICs

Note : A minimum of EIGHT experiments must be performed.

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragati prakashan, 1976

Syllabus for VI Sem. B.Sc. (Physics) Paper VIII – Phy T603:

ELECTRONICS, MAGNETIC MATERIALS, DIELECTRICS AND QUNTUM MECHANICS – II

UNIT I : OPAMPS

Operational amplifiers

Block Diagram of an OPAMP, Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open loop configuration - Limitations, Gain Bandwidth Product, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground **2 hours**

Feedback concepts, Advantages of feedback, types of feedback, Expression for Gain; OPAMP as a feedback amplifier – Non – Inverting and Inverting amplifier, Modification of input and output impedances with feedback ; Voltage follower; Differential amplifier with feedback;

2 hours

Linear Applications - frequency response of Low pass, high pass and band pass filters (first order), inverting summing amplifier, ideal Differentiator, Integrator;

2 hours

OPAMP Oscillators

Positive Feedback concept - oscillator operation –Barkhausen Criterion; Types of oscillator circuits (Qualitative); Phase shift oscillator and Wien bridge oscillator (using op amp).

2 hours

DIGITAL ELECTRONICS

Number Systems : binary, octal, hexadecimal (interconversions); Number codes : BCD, Gray Code (conversions to other systems); Signed Numbers; Arithmetic using Radix and Radix -1 complement.

2 hours

Logic gates and truth tables : OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR. **1 hour**

Boolean laws and theorems – simplification of SOP equations; Realization of AND, OR, NOT using universal gates NAND and NOR; **2 hours**

Combination logic: Adders (full and half adder) and Subtractors (half) **2 hours**

UNIT II – Magnetic Properties of Matter and Dielectrics

Magnetic Properties of Matter

Review of basic formulae : Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia – , Para –, and ferro – magnetic materials;

3 hours

Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials

5 hours

Dielectrics : Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, cause, examples and applications.

7 hours

UNIT-III : Quantum mechanics-II

The concept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger's wave equation. Max Born's interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, Eigen values and Eigen functions. Applications of Schrodinger's equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function – extension to three dimensional box; Development of Schrodinger's equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state.

15 hours

References

1. OPAMPS and Linear Integrated Circuits, **Ramakant A Gayakwad**, PHI Learning Private Limited, 4th Edition
2. Operational Amplifiers with Linear Integrated Circuits, **William D Stanley**, Pearson, 4th Edition
3. Electronic Devices and Circuit Theory**, Robert Boylestead and Louis Nashelsky**, PHI Learning Private Limited, 10th Edition
4. Digital Principles and applications, **Leach and Malvino**, MC – Graw Hill, 5th Edition
5. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996.**)
6. Solid State Physics**- A J Dekker**, MacMillan India Ltd, (**2000**)
7. Elementary Solid State Physic, **J P Srivastava**,PHI,(**2008**)
8. Essential of crystallography**, M A Wahab**, Narosa Publications (**2009**)
9. Solid State Physics**-F W Ashcroft and A D Mermin-**Saunders College (**1976**)
10. Solid State Physics**-S O Pillai-**New Age Int. Publishers (**2001**)
11. Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (**2004**)

12. Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education, (**2005**)

13. Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (**2000**)

14. Principles of Quantum Mechanics, ***Ghatak and Lokanathan***, Macmillan, (**2004**)

2004PHYSICS – 604, PRACTICAL PHYSICS – VI(B)

1. Low pass filter using Op-amp
2. High pass filter using Op-amp
3. Band pass filter using Op-amp
4. Op-amp inverting and non – inverting amplifier – ac or dc
5. OPamp as a differential amplifier – COMMON MODE AND DIFFERENTIAL MODE
6. Op-amp-summing amplifier – ac and dc,
7. OPamp as integrator and differentiator.
8. Phase shift oscillator using op –amp
9. Wien-bridge Oscillator using op – amp
10. To design an Astable Multivibrator of given specifications using 555 Timer
11. Determination of dielectric constant.
12. Determination of dipole moment of organic liquid
13. Verification of inverse square law using GM counter (with a radioactive source).
14. Determination of mass absorption coefficient of gamma rays.

Note : A minimum of EIGHT experiments must be performed.

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics, Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, (**2000**)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)

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BANGALORE UNIVERSITY

B. Sc., Chemistry Syllabus

I to VI Semesters
(w. e. f. 2014)

Department of Chemistry
Central College Campus
Bangalore - 560 001

FOREWORD

As per the directive from the Bangalore University, the Chemistry syllabus for the B. Sc., degree course (CBCS) had to be prepared. Guidelines for this were provided by the University.

In the Department of Studies in Chemistry, Central College, with the help of the Chemistry Teachers' Forum, a Core Group involving the Teachers of the University Department and affiliated colleges was constituted. This Core Group participated in work-shops held on 22.04.2014, 30.04.2014 and 19.05.2014, keeping in view the aims of the UGC Model Curriculum in developing interdisciplinary skills in students linking general studies with professional courses and allowing both vertical and horizontal mobility and also catering to local needs the syllabus was prepared.

Teachers of different branches of Chemistry, namely Inorganic, Organic, Physical and Biochemistry had separate and joint brainstorming sessions and arrived at a Draft Syllabus in Chemistry for SIX semesters. The Chemistry Teachers' Forum played a pivotal role during the drafting of the syllabus. The Draft Syllabus in chemistry was brought to the attention of a wider group of Teachers for further refinement on 23th May 2014. The final draft incorporating the suggestions was placed before the Department Council on 02. 6. 2014 and then the Board of Studies in Chemistry (UG) on 07. 6. 2014 for approval.

CHAIRMAN
Department of Studies in Chemistry
Central College Campus
Bangalore University
Bangalore-560 001

Members of the Committee for the Preparation of the Chemistry Syllabus for the B. Sc., Degree Course (Semester Scheme)

Chemistry Teachers' Forum: Bangalore University, Bangalore

Physical Chemistry Section

Dr. Girija C R	SSMRV College, Bangalore
Mr. Sripathi	Vivekananada College, Bangalore
Dr. Vasundara D E	BMS College, Bangalore
Ms. Malathi M	Rural College , Kanakapura
Mr. S. Uday Kumar	Rural College, Kanakapura

Inorganic Chemistry Section

Mr. H B Mallesh	GFGC, Channapatna
Mr. Vijaya Babu B.	GFGC, Vijayanagar
Mr. Ramanna	Kongadiappa College, Doddaballapura
Dr. Muddu Krishna K R.	Govt. First Grade College, Varthur, Bangalore
Ms. Hamsini S	GFGC Chickaballapur.
Ms. Vanitha G K	GFGC, Doddaballapur
Mr. G R Rangappa	GFGC, Kolar
C Sanjeevarayappa	GFGC, Yelahanka

Organic Chemistry Section

Dr. Shylaja S	GFGC, K R Puram, Bangalore
Dr. Rekha S	VVS First Grade College, Bangalore
Dr. Shashikala Devi K	Maharani Science College, Bangalore
Dr. Prathima Rao	Vivekananda College, Bangalore
Ms. Shamsiya Rizwana	M E S College, Bangalore
Mr. Sridhar B T	Maharani Science College, Bangalore

Biochemistry Section

Dr. Nanda N	BMS College for Women, Bangalore
Ms. Radhika R	GFGC, Channapatna
Ms. Kathyayini	National College, Gowribidanur.

Proceedings of the Meeting of Board of Studies in Chemistry (UG) held on 7th June 2014 at 10.30 am in the Department of Chemistry, Central College Campus, Bangalore-560 001.

The Chairman welcomed the members of the Board to the meeting and placed the agenda before them for discussion.

Agenda: 1. *Scrutiny and approval of the Syllabus for the B. Sc., Degree, Chemistry Course (Semester Scheme).*

2. *Preparation of the BOE (UG) and Professional Courses for the Academic Year 2014-15.*

The Chairman informed the members that, as per the directive from the Bangalore University, the Chemistry syllabus for the B. Sc., degree has been prepared with the help of the Chemistry Teachers' Forum which constituted a Core Group form affiliated Colleges, is proposed to be introduced from 2014 onwards. In this connection, the Core Group participated in workshops held on three days: 22. 04. 2014, 30. 04. 2014 and 19. 05. 2014 and prepared a Draft syllabus. The syllabus was then finalized in a workshop conducted on 23th May 2014 in the presence of a wider group of Teachers represented by most of the colleges offering Chemistry at UG level. The draft syllabus was then placed before the Department Council on 2. 6. 2014 for approval, the approved syllabus is now placed before the Board for Scrutiny and approval.

The Board of Studies (UG) approved the Syllabus after some modifications.

The Board also prepared the BOE (UG) Chemistry and BOE Professional Course (BE., Chemistry).

The meeting ended with the vote of thanks by the Chairman.

The following members were present.

1. Dr. Shaheen Taj
2. Sri. R. Vinay Kumar
3. Sri. S. Vijay Kumar
4. Sri. H. B. Mallesh
5. Sri. G. Siddalingaiah
6. Smt. M. Malathi
7. Dr. Venkatesha, B. M (External Member)
8. Dr. Nanjundaswamy, N (External Member)
9. Dr. M. A. Pasha Chairman, (BOS, UG)

SCHEME OF EXAMINATION

Title of the paper	Contact hours/Week	Exam. hours	IA	Marks	Total Marks	Credits
First Semester						
Chemistry-I	4	3	30	70	100	2
Chemistry Practical-I	3	3	15	35	50	1
Second Semester						
Chemistry-II	4	3	30	70	100	2
Chemistry Practical-II	3	3	15	35	50	1
Third Semester						
Chemistry-III	4	3	30	70	100	2
Chemistry Practical-III	3	3	15	35	50	1
Fourth Semester						
Chemistry-IV	4	3	30	70	100	2
Chemistry Practical-IV	3	3	15	35	50	1
Fifth Semester						
Chemistry-V	3	3	30	70	100	2
Chemistry- VI	3	3	30	70	100	2
Chemistry Practical-V	3	3	15	35	50	1
Chemistry Practical-VI	3	3	15	35	50	1
Sixth Semester						
Chemistry-VII	3	3	30	70	100	2
Chemistry VIII	3	3	30	70	100	2
Chemistry Practical-VII	3	3	15	35	50	1
Chemistry Practical-VIII	3	3	15	35	50	1

B. Sc., – I Semester
Paper- I

UNIT-I

Mathematical Concepts for Chemistry **4 hours**

Logarithmic relations: Definition, some important relations like log*(m+n),* $\log\left(m/n\right)$, *log* m^n, change of base ($\log_e 2 \rightarrow \log_e x$). Application in the calculation of pH.

Curve sketching: How a cure is sketched with a set of points: linear and non-linear (asymptotic) with a set of points, sketching both linear and non-linear curves. Calculation of slope in the case of linear curve.Extrapolation of linear curve and arriving at a limiting value.

Parabolic curve- maximum and minimum. *Differentiation*: Meaning and derivative of functions like e^x, log *x*, *sin x, cos x,* $1/x$, x^2, $x^x$and $\sqrt{n}$, $\frac{dy}{dx} = 0$ at maximum and minimum.

2^{nd} *order differentiation*: for maximum and minimum (derivation from first principles not required). Rules of differentiation for $y = u + v$, $y = uv$, $y = \frac{u}{v}$ and $y = ku$, where *k* is constant.

Partial differentiation: Explanation, applications using the equation, H = U + PV and G = H − TS.

Integration: Meaning and integrals of functions like, *x, dx,* x^2, $1/x$, $1/x^2$, $1/x^3$, x^n, e^x, *sin x* and *cos x*. simple problems from I and II order kinetics.

Exact and inexact differentials: Examples from internal energy and enthalpy. *Definite integrals*.

Probability: some definitions, examples from atomic orbitals, wave functions and entropy.

Gaseous state **9 hours**

***Introduction*:** Need for Maxwell-Boltzmann distribution law, mathematical expression for both mole and molecule-explanation of the terms only. Explanation of velocity distribution curves based on this law (no derivation). Mean free path, collision frequency and collision number. Definition and expressions using SI units (no derivations). Derivation of expression for most probable speed from Maxwell-Boltzmann equation Definitions and expressions for rms velocity and average velocity, relationships between them. Problems.

Andrew's isotherm on carbon dioxide and explanation of the curves (no experimental details). Derivation of critical constants T_c, P_c and V_c from van der Waal's equation and their experimental determination by Cagniard de La Tour method for T_c and P_c. Amagat's mean density method for V_c. Problems on the calculation of T_c, P_c and V_c, *a* and *b*.

Law of corresponding states-statements, reduced equation of state and explanation, Joule-Thomson effect-explanation. Joule-Thomson co-efficient, inversion temperature-definition (no derivation).The application of Joule-Thomson effect to the liquefaction of air and hydrogen by Linde's process.

UNIT-II

Photochemistry **4 hours**

Laws of photochemistry. Grotthus-Draper law, Stark-Einstein law, differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions. Quantum yield of photochemical combination of (i) H_2 and Cl_2 (ii) H_2 and Br_2 (iii) dissociation of HI (iv) dimerisation of anthracene. Photosensitization, photostationary

equilibrium. Singlet and triplet states. Fluorescence, phosphorescence, luminescence, bioluminescence and chemical sensors.

Beer-Lambert's law and its applications. Numerical problems on absorption coefficient and molar extinction coefficient.

Liquids and Solutions **9 hours**

Properties of liquids-Viscosity, Surface tension and Parachor-Definition, mathematical expression, numerical problems and factors affecting them.

Viscosity- Definition, mathematical expression, Coefficient of viscosity, effect of temperature, size, weight, shape of molecules and intermolecular forces on it.

Surface Tension-Definition, mathematical expression, effect of temperature and solute on it

Parachor-Definition, Sugen equation, calculation and applications. Numerical problems.

Liquid Mixture: Review of Raoult's law, ideal and non-ideal solutions.

Completely miscible liquids-Fractional distillation Tc curves for all the three types, azeotropic mixtures -examples.

Completely miscible liquids-Critical solution temperature (Three types), examples. Effect of addition of salt on CST of phenol-water system.

Immiscible liquids-Steam distillation and its applications.

Distribution law-Statement, partition coefficient and condition for validity of distribution law. Application-solvent extraction

Dilute solutions- Review of colligative properties and concentration terms

Determination of molecular mass of a solute by: (i) Berkeley-Hartley's method (π); (ii) Beckmann's method (ΔT_f) and (iii) Landsberger's method. Numerical problems.

UNIT-III

Periodic Table and Periodic properties **9 hours**

Review of the modern periodic table (with respect to classification of elements based on outer electronic configuration)

Periodic properties: Atomic and ionic radii, ionisation energy, electron affinity and electronegativity. Trends in the periodic properties. Applications in predicting and explaining chemical behaviour. Factors affecting the values of ionisation energy. Determination of electronegativity by Pauling's method. Diagonal relationship between beryllium and aluminium. Comparitive study of elements of alkali and alkalline earth metals, chalcogens and halogens with respect to electronic configuration, atomic and ionic radii, ionisation energy, and elecronegativity. Halides, oxides and carbonates of alkali and alkalline earth metals. Hydrides of chalcogens and halogens.

Analytical Chemistry **4 hours**

Errors: Classification, minimization of determinate errors, accuracy and precision. Significant figures and their computations.

Equivalent weights of acids, bases, salts, oxidising and reducing agents. Methods of expressing concentration of solutions in terms of Normality and Molarity. Numerical problems.

UNIT-IV

Basic concepts in organic chemistry **4 hours**

Bond cleavage – homolytic and heterolytic. Types of reagents – electrophilic and nucleophilic reagents. Reactive intermediates - generation and relative stabilities of carbocation, carbanion, carbon free radicals and carbenes – explanation for stability and reactivity based on inductive, resonance and hyperconjugation effects.

Types of reactions - addition, substitution and elimination. Concept of isomerism - structural isomerism, stereo isomerism - geometrical and optical isomerism, chiral center – definition and examples. Tautomerism (keto – enol).

Aliphatic Hydrocarbons **9 hours**

Alkanes: Sources, Nomenclature of branched chain alkanes, preparation of symmetrical and unsymmetrical alkanes- Corey- House reaction and Wurtz reaction - their merits and demerits.

Conformational analysis of n-butane - Sawhorse and Newman projection formulae to be used - Energy profile diagram.

Cycloalkanes: Nomenclature. Method of formation. Explanation for stability based on heat of hydrogenation data, Baeyer's strain theory and its limitation, Sachse - Mohr theory of strain-less rings; cyclopropane ring - banana bonds.

Alkenes: Preparation of alkenes by Wittig reaction-stereoselectivity. Addition of HX to unsymmetrical alkene - Markownikov's rule and Antimarkownikov's rule with mechanism. Reactions: Hydroboration- oxidation, reduction, oxymercuration - demercuration, epoxidation. Mechanism of oxidation with $KMnO_4$ and OsO_4.Ozonolysis- mechanism and importance.

Dienes: Classification- isolated, conjugated, cumulated. Structure of allene and butadiene.1,2 addition and 1,4 addition reactions. Diels Alder reaction-1,3-butadiene with maleic anhydride.

Alkynes: Methods of preparation - Dehydrohalogenation of vicinal and geminal dihalides; and higher alkynes from terminal alkynes. Reactions - metal ammonia reduction – significance. Oxidation with $KMnO_4$, acidic nature of terminal alkynes.

B. Sc., – II Semester
Paper- II

UNIT-I

Quantum Mechanics and Atomic Structure **13 hours**

Review of Bohr's atomic model:
Derivation of expressions of for radius, energy and ionisation energies of hydrogen like atoms. Numerical Problems.
Limitations of classical mechanics. Wave particle duality, Uncertainty principle.
New quantum mechanics-Sinusoidal wave (Explain sinusoidal wave.) equation (classical wave mechanics); Schrodinger wave equation- derivation. Postulates of quantum mechanics.
Significance of terms- (i) Hamiltonian operator; (ii) eigen function Ψ (significance of ψ and ψ^2); (iii) eigen values.
Application of Schrodinger equation: (i) to particle in one dimensional box (derivation required); (ii) to the hydrogen atom (detailed solution not required)
Expressing the solution as a product of $\psi_{n,\,l.\,m}\,(r, \theta, \phi) = \psi_{n,\,l.\,(r)}\psi_{\,l.\,m(\theta,\,\phi)}$
Explanation of quantum numbers (only qualitative). Radial probability distribution and angular probability distribution. Orbitals

UNIT-II

Chemical bonding **13hours**

Ionic bond: Lattice energy, Born-Haber cycle, Born-Lande equation (derivation not required, problems on Born-Lande expression to be worked out). Calculation of lattice energies of NaCl and MgO,effect of lattice energy on solubility of ionic compounds.
Covalent bond: Valence bond approach: hybridization and directional characteristics of sp, sp^2, sp^3, sp^2d, sp^3d^2. Shapes of $BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6.VSEPR theory: shapes of CH_4, NH_3, NH_4^+, H_2O, BrF_3, ICl^{2-}.Molecular orbital theory: H_2, He^{2+}, Be_2, N_2, O_2, O^{2-}, O_2^{2-}, O^{2+} and CO (bond order, stability and magnetic properties to be discussed). Polarization concept, Fazan's rule, bond length, bond angle and bond energy, polar and non-polar molecules, dipole moment.
Weak interactions: i). Hydrogen bond: Intra molecular and Intermolecular types, anomalous properties of HF, H_2O, NH_3, alcohols, carboxylic acids, nitro phenols and bio molecules.
ii) van der Waal's forces: Noble gases and molecular crystals (dry ice, Iodine and solid SO_2)
Metallic bond: Band theory, electrical properties of metals, semiconductors and insulators.

UNIT-III

Silicates **2hours**

Structure of SiO_4^{4-}, Classification of silicates based on the structure. Zeolites: their structure and applications.

Noble gases **3hours**

Introduction, isolation of Helium from Natural gas, applications of Noble gases. Preparation properties and structures of fluorides and oxides of Xenon (XeF_2, XeF_4, XeF_6, XeO_3, XeO_4).

General study of d and f block elements. **8hours**

Transition elements: electronic configuration, atomic and ionic radii, ionisation energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

UNIT-IV

Aromatic hydrocarbons **9 hours**

Nomenclature. Structure of benzene - using molecular orbital theory. Criteria for aromaticity-Huckel's rule (Examples: cyclopentadienyl anion, cycloheptatrieneylcation, benzene, naphthalene, anthracene and phenanthrene). Antiaromaticity.

General mechanism of aromatic electrophilic substitution. Mechanism of nitration of benzene including evidence for the formation of nitronium ion, energy profile diagram and isotopic effect. Orienting influence of substituents in toluene, chlorobenzene, nitrobenzene and phenol.

Aromatic nucleophilic substitution *via* benzyne intermediate, mechanism with evidences for the formation of benzyne by trapping with anthracene, Birch reduction.Side chain oxidation of toluene to benzaldehyde and benzoic acid. Oxidation of naphthalene, anthracene and phenanthrene. Diels-Alder reaction of anthracene with 1,2-dichloroethene.

Alkenyl benzenes: Styrene, *cis*- and *trans*-stilbenes and their preparations.
Biphenyl: Preparation-Ullmann reaction.

Organic halogen compounds **4 hours**

Alkyl halides: Nomenclature. Nucleophilic substitution reactions - S_N1 andS_N2 mechanisms with energy profile diagrams. Effect of (i) nature of alkyl groups,(ii) nature of leaving groups, (iii) nucleophiles and (iv) solvents on S_N1 and S_N2 mechanisms. Elimination reactions - E1 and E2 mechanisms; Hofmann and Saytzeff eliminations with mechanism.

Aryl halides: Preparation by halogenation. Relative reactivity of alkyl, allyl, vinyl, aryl and aralkyl halides towards nucleophilic substitution.

B. Sc., –III Semester
Paper III

UNIT-I

Chemical Kinetics **7 hours**

Review of terms –Rate, Order and Molecularity.

Derivation of expression for the rate constant of a second order reaction with $a = b$ and $a \neq b$. Expression for half-life of a second order reaction. Mean life for first order reaction to be mentioned. Problems on rate constant, half-life period, mean life period and order of reaction.

Determination of order of reaction: differential method, method of integration, method of half-life period and isolation method.

Theories of reaction rates: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Problems.

Simple collisions theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Steady state approximation and Lindemann's hypothesis.

Experimental determination of kinetics of: (i) inversion of cane sugar by polarimetric method, (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide.

Thermodynamics I **6 hours**

Exact and inexact differentials. Review of terms, I law of Thermodynamics.

Work done (derivation with problems) in isothermal and adiabatic expansion and compression of an ideal gas (IUPAC sign conventions to be used).

Heat capacity of a gas at constant pressure and constant volume: relation between P, V and T in an adiabatic process to be derived. Derivation of Kirchoff's equation. Numerical problems.

Spontaneous and non-spontaneous processes.

Second law of thermodynamics: Limitations of I law of thermodynamics with illustrations. Need for II law of thermodynamics, different ways of stating II law with respect to heat and spontaneity. Other forms of II law of thermodynamics. Concept of entropy and its physical significance-illustrations with order, disorder, physical and chemical processes and probability.

Heat engine-Carnot's cycle and derivation of the expression for its efficiency. Problems based on efficiency equation. II law in terms of efficiency (η). Change in entropy in reversible and irreversible processes (derivations required) . Calculation of entropy changes in reversible isothermal and reversible adiabatic processes. Phase transitions in terms of Entropy (Fusion, vaporization, sublimation and polymorphic changes) in terms of entropy. Limitations of the entropy concept of spontaneity. Problem on Phase transitions

UNIT-II

Thermodynamics II **4 hours**

Gibb's free energy: Work function, chemical potential. Definition and relationship between free energy and work function. Criteria for equilibrium and spontaneous processes. Gibb's-Helmholtz equation-Derivation. Change of free energy with respect to temperature and pressure. Mention of temperature coefficient, van't Hoff isotherm (derivations included), $\Delta G^\circ = -RT\, ln K_p$ Problems.

Derivation of van't Hoff reaction isochore and Clausius-Clapeyron equation. Its applications to ΔT_b and ΔT_f determination (thermodynamic derivation not required).
Qualitative treatment of Nernst heat theorem and III law of thermodynamics-statement only. Elementary concept of residual entropy.

Surface chemistry **4hours**

Review of surface phenomena.
Theories of adsorption . Adsorption isotherms and BET equation (derivation included), Adsorption indicators. Surface film on liquids.
Catalysis –Types and theories ((intermediate compound theory and adsorption theory).
Heterogeneous catalysis: surface reactions, unimolecular, bi-molecular surface reactions. pH dependence of rate constant of catalysed reactions. Autocatalysis.

Organic and Inorganic Polymers **3hours**

Differences between inorganic and organic polymers.
Polymerisation: types: addition and condensation polymerisation
Molecular weight of Polymers: Expression for Weight average and Number average (experimental determination is not required)
Preparation and applications of the following types of polymers
1. Plastics: i)thermosetting plastics(Phenol-formaldehyde)
   ii) thermo softening plastics(PVC)
2. Fibers: Acrylic, polyamide, polyester types: one example for each
3. Rubber: Neoprene,
4. Fluoro Carbons: Teflon
5. Silicones.

Compounds of some Nonmetals. **2hours**

i) Boron and its compounds: Synthesis, structure and applications of Diborane, Borazole and Boron trifluride.
ii) Halogens and its Compounds: Bleaching powder: manufacture and its applications.

UNIT-III

Metallurgy **5 hours**

Ellingham's diagrams: Salient features. Selection of reducing agents using Ellingham's diagrams.Extraction of the following metals.
i) Nickel from sulphide ore
ii) Thorium from Monazite sand
iii) Uranium from Pitch blende
iv) Plutonium from Nuclear waste.

Alcohols and Thiols **8 hours**

Alcohols: Introduction and classification. Methods of preparation - (i) From carbonyl compounds - reduction of aldehydes and ketones (by Meerwein-Pondorff-Verley reaction);
(ii) from acids and esters (by reduction with $LiAlH_4$); (iii) From alkenes (by hydroboration-oxidation with alkaline peroxide); (iv) hydration of alkenes. Reactions of alcohols: Acidic nature, esterification, oxidation of alcohols with $KMnO_4$. Comparison of the reactivity of 1°, 2° and 3° alcohols- Lucas test, oxidation with $K_2Cr_2O_7$.

Glycols: Preparation from alkenes using OsO_4, $KMnO_4$ and from epoxides. Oxidation of glycols by periodic acid and lead tetraacetate with mechanisms. Pinacol-pinacolone rearrangement.

Glycerol: Preparation from propene and from oils/fats. Uses. Reactions of glycerol: (i) nitration, (ii) action of concentrated H_2SO_4 and (iii) oxidation by periodic acid.

Thiols: Nomenclature. Methods of formation and chemical reactions (with sodium, NaOH, metal oxides, formation of thioesters and oxidation with mild and strong oxidizing agents).
Uses of dithianes. Introduction of umpolung character (reversal of polarity) in carbonyl compounds.

UNIT-IV

Phenols **3 hours**

Classification. Acidic nature - Comparison of acidic strength of phenol with alcohols and monocarboxylic acids. Effect of electron withdrawing $-NO_2$ group and electron donating $-CH_3$ group on acidity of phenols at *o-,m-,p-* positions. Pechmann reaction, Mechanisms of Reimer-Tiemann and Kolbe-Schmidt reactions.
Industrial applications of phenols: Conversion of phenol to (i) aspirin, (ii) methyl salicylate, (iii) salol, (iv) salicyl salicylic acid.

Ethers and Epoxides **4 hours**

Ethers: Methods of preparation – (i) dehydration of alcohols, (ii) Williamson's ether synthesis. Reactions – Ethers as Lewis bases (complexation with metal ions), cleavage and auto-oxidation. Ziesel's method.

Epoxides: Preparation using per acids, Darzen's reaction. Reactions of mono and 1,2-disubstituted epoxides with (i) carbon nucleophiles, (ii) nitrogen nucleophiles, (iii) reduction with $LiAlH_4$.

Fertilizers **4hours**

Introduction(need of fertilizers), functions of essential plant nutrients(N,P,K),
Classification of fertilizers with examples. Nitrogeneous, Phosphatic and mixed fertilizers with suitable examples. Manufacture of urea and Super phosphate of lime, and their uses.
Fertilizer industries in India.

Organometallic compounds **2 hours**

Preparation and synthetic applications of Grignard reagents, Organolithium compounds and lithium dialkylcuprates.

B.Sc., IV -Semester
Paper –IV

UNIT-I

Phase Equilibria 7 hours

Statement and explanation of the terms with examples for phase (P), component (C) and degree of freedom (F), Definition and significance of phase rule. Derivation of phase rule. Application of phase rule to one component systems-water and sulphur, -modified form of phase rule to two component systems. Water–potassium iodide and lead-silver systems. Eutectic mixtures and their applications (examples: freezing mixtures, desilverisation of lead by Patterson's method).

Solid state 6 hours

Crystalline state, Laws of crystallography. Symmetry elements in crystals, crystal systems.Weiss and Miller indices. X-ray diffraction of crystals-derivation of Bragg's equation, . Problems
Liquid crycstals-Types with examples. Applications
Superconducting solids-High temperature superconductors. Applications.

UNIT-II

Water Technology 3hours

Types of impurities present in water. Causes for the hardness of water. Permissible levels of ions present in water. Treatment of water for domestic and Industrial purposes by the following methods.
i) Demineralisation of water by Ion exchange method.
ii) by reverse Osmosis method.

Nuclear and Radiochemistry. 8hours

Nucleus: Structure and stability, binding energy calculations. Instability of the nuclei, radioactive decay law, half life: numerical problems. Radioactive equilibrium, radioactive series. Artificial radioactivity: Nuclear reactions induced by γ-radiation,α,n,p,and d particles. Nuclear fission and fusion. Nuclear reactors, Breeder reactors, atomic energy programme in India. Isotopes- use of radio isotopes in tracer technique, agriculture, medicine, food preservation and Carbon dating-Numerical problems.

Powder metallurgy 2hours

Advantages of powder metallurgy and its applications. Methods of production of metal powders. production of Tungsten powder from Wulframite.

UNIT-III

Steel 5hours

Iron-Carbon Phase diagram, Austenite, Ferrite, Cementite and Pearlite phases.
Alloy steels: Influence of Si, Mn, Cr, Ni, Ti and W on the properties of Steel.
Ferro alloys: Production of ferro chrome, ferro manganese, and ferro silicon and their applications.
Carbon steel: classification. Heat treatment: hardening, case hardening, carbiding, nitriding, tempering and annealing.

Aldehydes and Ketones 8hours

Nomenclature. Preparation of aldehydes: from acid chlorides (Rosenmund reaction), Gattermann-Koch aldehyde synthesis. Preparation of Ketones: From nitriles, from carboxylic acids with alkyl lithium, from acid chlorides with metal alkyls.
Mechanisms of: Aldol condensation, Perkin condensation, Knoevenagel condensation, Benzoin condensation and Acetal formation. General mechanism of condensation with ammonia and its derivatives (NH_2−R; R = −NH_2, −OH, −NH−CO−NH_2).
Reduction: Reduction by $LiAlH_4$ and $NaBH_4$. Mannich reaction. Mechanisms of Clemmensen and Wolff-Kishner reductions.

UNIT-IV

Carboxylic acids and their derivatives. 5 hours

Nomenclature. Preparation: Acid hydrolysis of nitriles with mechanism.

Acidic strength (pK_a values) - Effect of substituents on the strength of aliphatic and aromatic carboxylic acids. (comparison of acidic strength of formic and acetic acids; acetic acid and monochloro, dichloro, trichloro acetic acids ; benzoic and p-nitrobenzoic acid; benzoic acid and p-aminobenzoic acid)

Reactions: Formation of esters, acid chlorides, amides and anhydrides. Hell-Vollhardt-Zelinski reaction, Decarboxylation and reduction (using $LiAlH_4$). (already included under preparation of alcohols from acid)

Di and tri carboxylic acids: Action of heat on dicarboxylic acids (Oxalic to Adipic acids)

Reactions of tartaric acid and citric acid. (action of heat, reduction with HI).

Reactions of acid chlorides (hydrolysis, reaction with alcohol, ammonia and lithium dialkylcuprates) .Acid anhydrides (hydrolysis, reaction with alcohol, ammonia).Esters (alkaline hydrolysis, ammonolysis and alcoholysis).Amides (hydrolysis, reduction, Hoffmann rearrangement). Mechanism of ester hydrolysis - acid and base catalysed (acyl O-cleavage: $B_{AC}2$, $A_{AC}2$; alkyl O-cleavage: $A_{AL}1$ mechanisms).

Tautomerism and Enolates 4 hours

Tautomerism in carbonyl compounds – Keto-Enol tautomerism. Acidity of α-hydrogen atoms in aldehydes, ketones and active methylene compounds (example diethyl malonate, ethyl acetoacetate and acetyl acetone). Preparation of (from acetic acid) and synthetic applications of diethyl malonate (preparation of monocarboxylic acids - butanoic acid, dicarboxylic acid - Adipic acid, unsaturated acids - cinnamic acid, ketones - butanone, cyclic compounds - barbituric acid)

Preparation of ethyl acetoacetate (from ethyl acetate). Synthetic applications of ethyl acetoacetate (preparation of monocarboxylic acids - butanoic acid, dicarboxylic acid –succinic acid, unsaturated acids - crotonic acid, ketones - butanone).

Environmental Chemistry 4hours

Depletion of ozone in the stratosphere. causes and remedial measures. The green-house effect and its consequences. Acid rain, photochemical smog. Treatment of sewage and industrial effluents. Disposal of radioactive wastes.

B.Sc., - V Semester
Paper V

UNIT-I

Stereochemistry **8hours**

Elements of symmetry in chiral and achiral molecules, chirality, stereogenic centre. Fischer projection formulae.

Enantiomers: Optical activity; use of +/–, *d/l* and D/L notations. Properties of enantiomers, chiral and achiral molecules with two stereogenic centers. Meso compounds. Cahn-Ingold-Prelog sequence rules: R, S system of nomenclature.

Diastereomers: Threo and Erythro isomers.

Racemisation and resolution. Relative and absolute configuration.

Optical isomerism due to restricted rotation about single bonds- diphenyl systems.

Geometric isomerism: Determination of configuration of geometric isomers. Cis & trans, E, Z system of nomenclature. Geometric isomerism in oximes.

Alicyclic compounds: Conformations of four to eight membered cycloalkanes and disubstituted cyclohexanes.

Bicylic systems: Nomenclature and conformations of decalins and norbornane.

UNIT-II

Amines **5hours**

Classification. Preparation of alkyl and aryl amines-reductive amination of carbonyl compounds, Gabriel phthalimde synthesis. Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles – Methylation, quarternary salts, Hoffmann elimination with mechanism. Distinguishing reactions of 1°, 2° and 3° amines.

Diazotization and synthetic applications of diazonium salts.Sandmeyer's reaction. (conversion to chlorobenzene, bromobenzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azo dyes (*p*-hydroxyazobenzene and 1-phenylazo-2-naphthol).

Heterocyclic compounds **4hours**

Introduction, classification, structures, resonance and aromatic character of furan, pyrrole, thiophene and pyridine. Methods of preparation and reactions of pyrrole, furan, thiophene, pyridine. Mechanism of electrophilic substitution reactions. Comparison of basicity of pyrrole, pyridine and piperidine. Preparation and reactions of indole, quinoline and isoquinoline.

UNIT-III

Chemistry of Natural Products **10hours**

Carbohydrates: Introduction and classification.

Monosaccharides: Aldoses, structures of all the D-aldohexoses. Elucidation of open chain structure of D-glucose.Mechanism of mutarotation and anomeric effect.Elucidation of ring structure of D-glucose in detail.

Ketoses: Fructose, interconversion of glucose and fructose.

Disaccharides: Glycosidic bond. Structures of maltose, lactose and sucrose-Haworth and conformational structures.

Terpenes and terpenoids: Occurrence, classification and isoprene rule. Elucidation of structure and synthesis of citral and zingiberene.Structures of limonene, menthol, α-terpineol, camphor, β-carotene, Vitamins-A and their uses.

Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine.Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

UNIT-IV

Spectroscopy of Organic compounds **8 hours**

UV-Visible spectroscopy: Introduction. Chromophores and auxochormes; blue shift and red shift. Graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Influence of conjugation on UV absorption-Comparison of UV spectra of acetone and methyl vinyl ketone.

IR spectroscopy: Introduction. Stretching frequencies of −OH (free and H-bonded), alkyl −C−H, C≡C, C=C, C−C, C=O and C−O groups (by taking suitable examples). Graphical representation of IR spectra of benzoic acid and methyl benzoate.

NMR spectroscopy: Basic principles of proton magnetic resonance: Nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, spin population, saturation using radio frequency. Nuclear magnetic resonance.chemical shift (δ values), uses of TMS as reference. Nuclear shielding and deshielding effects.Equivalent and non-equivalent protons.Effect of electronegativity of adjacent atoms on chemical shift values.Spin-spin splitting and spin-spin coupling (qualitative treatment only).

Applications of NMR spectroscopy including identification of simple organic molecules. E*xamples*: Shielding and deshielding effects for (i) methane (ii) CH_3−Cl (iii) CH_2Cl_2 (iv) $CHCl_3$. Spin-spin coupling in (i) Cl_2CHCHO (ii) 1,1,2-trichloroethane (iii) CH_3CH_2Cl.

Industrial Organic chemistry **5 hours**

Synthetic dyes: Introduction and classification. Colour and constitution. Synthesis of congo red, malachite green, alizarin and indigo.

Drugs: Chemotherapy, classification of drugs. Synthesis and uses of paracetamol, diclofenac, ranitidine, sulphanilamide and chloramphenicol.

Introduction to Green Chemistry: Principles of Green chemistry and its application to the synthesis of paracetamol.

B. Sc., - V Semester
Paper VI

UNIT-I

Electrochemistry I **10 hours**

Review of electrolytes and Conductance related terms

Methods of determination of molar conductance. Conductometric titrations (only acid-base type). Transport numbers: definition – determination by moving boundary method. Causes of abnormal transport numbers observed in certain systems. Ionic mobility. Problems on transport numbers. Conductivity of water.

Kohlrausch's law and its applications: (i) evaluation of Λ_∞ from Λ_+ and Λ_- (ii) evaluation of degree of dissociation of a weak electrolyte (iii) evaluation of Λ_∞ of a weak electrolyte (iv) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl and $BaSO_4$). Problems based on these.

Limitations of Arrhenius theory: qualitative account of Debye-Huckel theory, Debye-Huckel-Onsagar equation for aqueous solutions of 1:1 electrolytes. Verification of DHO equation.

Galavanic cell: conventions of representing galvanic cells-reversible and irreversible cells, derivation of Nernst equation for single electrode potential (free energy concept).

UNIT-II

Electrochemistry II **5 hours**

Weston-cadmium cell:Determination of emf of a cell by compensation method. Determination of E° of Zn/Zn^{2+} and Cu/Cu^{2+}electrodes.Liquid junction potentials, elimination of liquid junction potential.

Types of electrodes: Metal and gas electrodes (chlorine), metal/metal insoluble salt electrodes, redox electrodes. Reference electrodes-standard hydrogen electrode, calomel electrode, quinhydrone electrode and glass electrode. Determination of pH using these electrodes. Numerical problems.

Concentration cells: (i) emf of concentration cells (ii) determination of solubility of sparingly soluble salts and numerical problems. Redox electrodes, emf of redox electrodes. Potentiometric titration involving only redox systems.

Ionic equilibria **3 hours**

Hydrolysis of salts of weak acids and weak bases.Ionic product of water. Relationship between K_h, K_w, K_a and K_b. Degree of hydrolysis and its relationship with K_h. Effect of temperature and dilution on degree of hydrolysis. pH of salt solutions. Problems.

Common-ion effect, buffers, buffer action and buffer capacity. pH of buffers. Henderson's equation and its derivation. Solubility product and ionic product in precipitation and in qualitative analysis.

Analytical and biological applications of buffers.

Theories of indicators.

UNIT-III

Physical properties and Molecular structures **5 hours**

Polarization and orientation of dipoles in an electric field. Dipole moment. Induced dipole moment (experimental determination of dipole moment not included). Clausius-Mossotti equation (only statement).Dipole moment and structure of molecules (planar and non-planar).

Magnetic properties-paramagnetic, diamagnetic and ferromagnetic systems. Electrical properties of solids: types of solids-metals, insulators and semiconductors. Pyroelectricity, piezoelectricity, ferroelectricity, inverse piezoelectricity. Thomson effect, Seebeck effect and Peltier effect-definition with examples.

Chemical Spectroscopy I **5 hours**

The interaction of radiation with matter. Regions of electromagnetic spectrum and associated spectroscopic techniques.

Origin of molecular spectra: Born-Oppenheimer approximation.

Rotational spectra of diatomic molecules: Relationship between internuclear distance and moment of inertia. Expression for rotational energy. Numerical problems. Criterion for absorption of radiation-selection rule.

UNIT-IV

Chemical Spectroscopy II **4 hours**

Vibrational spectroscopy*:* Hooke's law- Expression for the frequency of SHO-force constant and its significance. Expression for vibrational energy levels of SHO. Zero point energy., numerical problems. Degree of freedom of polyatomic molecules– modes of vibration for CO_2 and H_2O molecules.

Raman spectroscopy: **3 hours**

Concept of polarisability. Pure rotation, vibration, qualitative study. Stokes and anti-Stoke's lines-selection rules.

Advantages of Raman spectroscopy over IR spectroscopy.

Electronic spectroscopy: Potential energy curves for bonding and antibonding molecular orbitals. Electronic transitions –qualitative description of non-bonding orbitals and transitions between them. Selection rules and Franck-Condon principle.

Electroanalytical Methods **5 hours**

Voltammetry at a dropping mercury electrodes (DME)-Types of current obtained at DME. Ilkovic equation and its applications. Current –potential relation for a cathodic process – half wave potential.

Cyclic Voltammetry-Principles-Experimental set up-Quantitative analysis, determination of diffusion coefficients.

B.Sc., - VI Semester
Paper VII

UNIT-I

Coordination and Organometallic compounds I **10 hours**

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands) and ambidentate ligands, coordination number, nomenclature of coordination compounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory-postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$. Isomerism-Structural: ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism with examples.
Organometallic compounds – ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta^2\text{-}C_2H_4)]$ and $[Fe(\eta^5\text{ - }C_5H_5)_2]$,

UNIT-II

Coordination and Organometallic compounds II **4 hours**

Metal carbonyls – $Cr(CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$; eighteen electron rule and its deviations with examples.
Applications of coordination/organometallic compounds: *cis*-platin in cancer therapy, Na_2Ca EDTA in the treatment of heavy metals (Pb, Hg) poisoning, Wilkinson's Catalyst in alkene hydrogenation, Monsanto acetic acid process.

Industrial Materials I **6 hours**
Refractories: Properties, classification, determination of PCE values.
Abrasives – definition and classification with examples, applications, hardness, manufacture and importance of carborundum and tungsten carbide.
Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glass, safety glass, fire and bullet proof glasses.
Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators.
Cement: Raw materials grades, manufacture of Portland cement (by wet process), setting of cement.

UNIT-III

Industrial Materials II **7 hours**
Paints and Varnishes: Constituents of oil and emulsion paints and their role, constituents of varnishes.

Fuels: Characteristics, Calorific value and its determination using bomb calorimeter, Coal-Varieties, Gaseous fuels-advantages, constituents and their significance, production of Coal gas and composition of LPG. Octane number.
Explosives: Classification, preparation of dynamite and TNT.
Propellants: Characteristics, classification and their applications.

Bioinorganic Chemistry **3 hours**
Essential and trace elements in biological systems with reference to Na^{+}, $K^{+,}$ Ca^{2+}, Fe^{2+}, P, Cu, V and Ni. Metallo-porphyrins with special reference to haemoglobin, myoglobin and chlorophyll. Role of cobalamin (vitamin-B_{12}coenzyme) in living systems.

UNIT-IV

Chemistry of Newer materials **10hours**
Conducting polymers: Introduction, definition and examples-polyaniline, polyacetylene. Mechanism of conduction. Qualitative treatment of doping,Properties: elasticity with high electrical conductivities, Engineering and biological applications.
Super conductors: Introduction, definition, type1, type 2 and atypical. Preparation of high temperature super conductor-$\mathbf{Y_1Ba_2Cu_3O_{x\pm\delta}}$, BCS theory (qualitative treatment only) and general applications of high temperature super conductors.
Fullerenes: Introduction, definition, preparation and isolation of C_{60}. Structure and Chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of $C_{60.}$Commercial uses of $C_{60.}$Carbon nanotubes-Introduction, definition, examples and structure.
Nanomaterials: Introduction, definition and electronic structure. Different methods of production: Sol gel synthesis, inert gas condensation, mechanical alloying (ball milling), plasma synthesis, electrodeposition, and general applications.

B.Sc., - VI SEMESTER
Paper – VIII

UNIT-I

INTRODUCTION TO BIOCHEMSITRY **2hours**

Contributions of Lavosier, Wohler, Emil Fischer, Louis Pasteur, Embden, Meyerhof, Parnas. Hans Kreb, Michaelis and Menton, Watson and Crick, Chargaff, H.G. Khorana, Knoop, Pauling, Hopkins and Miescher. Elemental and biochemical composition of living organisms. Role of water in biochemical systems (mention the properties of water which makes water a solvent of life).

CARBOHYDRATES **4hours**

Structure and biological importance of derivatives of monosaccharides.

Amino sugars : β-D-glucosamine, galactosamine and their N-acetylated forms: N-acetylmuramic acid (NAMA); N-acetylneuraminic acid (NANA)

Sugar acids–structure and biological importance of D-gluconic acid, D-glucuronic acid and D-glucaric acid.

Sugar phosphates–structure and biological importance of Glucose-6-P, Fructose-6-P, Fructose-1,6-di-P, β-D-ribose-5-P and β-D-deoxyribose-5-P.

Structure and biological importance of oligosaccharides – isomaltose, cellobiose, trehalose.

Polysaccharides - source, comparative account of partial structure and biological function of starch, glycogen, cellulose, chitin and insulin.

LIPIDS **4hours**

Introduction, Classification.

Fatty acids–definition, classification as saturated and unsaturated with examples and structure (lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic and arachidonic acids). Essential fatty acids – definition with examples

Triglycerides–Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number and its significance, rancidity (oxidative and hydrolytic), biological importance of triglycerides.

Phosphoglycerides – general structure of 3-Sn–phosphatidic acid, lipid bilayer (as in cell membrane), micelles, liposomes and its applications, structure and biological importance of lecithin, cephalin, phosphatidylserine, phosphatidylinositol.

Cholesterol – definition, types (HDL, LDL and VLDL)

Sphingolipids–structure and biological significance of ceramide.

UNIT-II

PROTEINS **5hours**

α-amino acids: Introduction, structure, classification on the basis of polarity of R-groups, essential and non essential amino acids, ionic properties and reactions of amino acids with alcohol, nitrous acid and Ninhydrin.

Levels of organizations of Protein: Primary structure, Secondary structure (α-helix, triple helix eg., Collagen and β-pleated sheet), tertiary structure and forces stabilizing it, quaternary structure.
Denaturation and renaturation: Thermal renaturation-Aufinsen's experiment with ribonuclease.
Classification of proteins based on structure, composition and biological function (enzymes, hormones, transport agents, antibodies, structural materials with examples).

NUCLEIC ACIDS **3hours**
Types–Components of nucleic acids, bases, nucleosides and nucleotides with structures. Partial structure of polynucleotide.
Structure of DNA (Watson-Crick model) and RNA. Biological roles of DNA and RNAs.
Protein-nucleic acid interaction- chromatin and viral nuclear capsid.

HORMONES **2hours**
Definition.
Classification - a) amino acid derivatives (epinephrine and thyroxine); b) peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon); c) Steroid hormones (progesterone, testosterone) with functions.
Role of insulin and glucagon in glucose homeostasis.
Mediators of hormone action – Ca^{2+}, cyclic AMP.

UNIT-III

ENZYMES **4hours**
Introduction, Holo enzyme (apo enzyme and co enzyme).Active site, specificity.
Classification of enzymes (EC code number not required).
Enzyme substrate interaction- Fischer and Koshland models.
Enzyme kinetics–factors affecting rate of enzymatic reactions – enzyme concentration, substrate concentration, pH and temperature (mention M. M. equation).
Allosteric enzymes–definition and example
Enzyme inhibitions-Competitive, noncompetitive and uncompetitive inhibition with one example for each.

BIOLOGICAL OXIDATION **4hours**
Bioenergetics- Introduction-stages of energy transformation. Exergonic and endergonic reactions. Relationship between $\triangle G$ and Keq.
High energy phosphates–definition, examples, structural features of ATP that makes ATP a high energy phosphate (electro static repulsion, opposing resonance, solvation of ATP).
Examples of high energy phosphates other than ATP. Energy coupling in biological reactions (explain the concept with suitable examples).
Biological oxidation – comparison of oxidation with combustion using glucose as an example. Redox potentials of some biological important half reactions. Calculation of energy yield from biological redox reaction (oxidation of NADH by oxygen, reduction of acetaldehyde by NADH). Mitochondrial electrotransport chain, oxidative phosphorylation. Substrate level phosphorylation.

BIOCHEMICAL TECHNIQUES **2hours**

Principle and applications of:

- Paper chromatography and TLC.
- Electrophoresis–cellulose acetate membrane electrophoresis and PAGE.

UNIT-IV

METABOLISM **6hours**

Catabolism and anabolism (explanation with an example) – Carbohydrate metabolism, glycolysis, fate of pyruvate. TCA cycle, energetic.

Gluconeogenesis–definition, synthesis of glucose from lactate.

Fatty acid metabolism–activation of fatty acids, role of carnitine, β-oxidation pathway, energetics.

Protein metabolism–general aspects of amino acid degradation – transamination, deamination and decarboxylation. Urea cycle.

MOLECULAR BIOLOGY **4hours**

Central dogma of molecular biology–semi conservative replication and mechanism of DNA replication, transcription, translation.

DNA finger printing – Definition and its applications.

SUGGESTED BOOKS

Inorganic Chemistry

1. Advanced Inorganic Chemistry, 6th Edition
   F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Concise Inorganic Chemistry, 5th Edition
   J. D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, 4th Edition
   J. E. Huhee, E. A. Keiter and R. I. Keiter, Pearson Education Asia, 2000
4. Inorganic Chemistry, ELBS 2nd Edition
   D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
5. Environmental Chemistry
   A. K. De, Wiley Eastern Ltd., 1999.
6. Nuclear and Radiation Chemistry
   Sharma B. K, Goel Publishing House, 1987.
7. Modern Inorganic Chemistry
   W. L. Jolly, McGraw Hill Co.
8. Principles of Inorganic Chemistry
   B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998
9. Inorganic Chemistry, 3rd Edition (ISE)
   A G Sharpe, Addison Wesley, 1989.
10. Basic Inorganic Chemistry, 3rd Edition
    F. A. Cotton, G. Wilkinson, P. L. Gaus-John Wiley & Sons, 1995.
11. Essential Chemistry, International Edition
    R. Chang, McGraw Hill Co, 1996.
12. University Chemistry, 4th Edition (ISE)
    B. H. Mahan & R. J. Myers, Addison Wesley, 1989.
13. Essential Trends in Inorganic Chemistry
    C. M. P. Mingos, Oxford Univ Press, 1998
14. Chemistry, 3rd Edition
    P. Atkins &L.Jones, W. H. Freeman & Company, 1997.
15. Modern Chemistry, 4th Edition
    D. W. Oxicby, H. P. Gills & N. H. Nachtrieb, Saunders College Publishing, 1998.
16. Fundamental Concepts of applied Chemistry,
Jayashree Ghosh, S Chand Publications.
17. Industrial Chemistry,
    B. K. Sharma, Goel Publishing House

Organic Chemistry

1. Organic Chemistry, Paula YurkanisBruice, Prentice Hall, 2005.
2. Advanced Organic Chemistry
   F. A. Carey and R. J. Sundberg, Plenum, 1990.

3. Organic Chemistry, Vol I & II
I. L. Finar, ELBS, 1986, 1991, 2005
4. Organic Chemistry
R. T. Morrison and R. N. Boyd, Prentice Hall, 1991
5. Organic Chemistry, Maitland Jones, Jr., W. W. Norton & Company
6. Advanced Organic Chemistry
O. S. Bahl and A. Bahl., S. Chand & Co. 1995
7. Advanced Organic Chemistry
J. March, John Wiley & Sons, 2008.
8. Understanding Organic Reaction Mechanisms
A. Jacobs, CambridgeUniv Press, 1998.
9. Organic Chemistry
M. K. Jain, Nagin& Co., 1987
10. A Guide to Mechanism in Organic Chemistry
P. Sykes, Orient Longman, 2005.
11. Organic Spectroscopy
V. R. Dani, Tata McGraw Hill, 1998.
12. Organic Spectroscopy
W. Kemp, ELBS IV Edition, 1998.
13. Synthetic Drugs
G. R. Chatwaal, Himalaya Publications, 2000.
14. Steriochemistry of Organic Compounds ,
Ernest L. Eliel, Samuel H. Wilen, Wiley India Edition,1994

Physical Chemistry

1. Physical Chemistry, 7th Edition
P. W. Atkins and Julio de Paula, Oxford Univ. Press, 2002.
2. The Elements of Physical Chemistry, 3rd Edition
Peter Atkins, OxfordUniv. Press, 2000.
3. Physcial Chemistry – A molecular Approach
Donal A. Mcquarrie and John D. Simon, Viva Low-priced Student Edition, 2001.
4. Introduction to Physical Chemistry, 3rd Edition
Mark Ladd, Cambridge Low-Priced Edition, 1999.
5. Text Book of Physical Chemistry
S. Glasstone, MacMillan India Ltd., 1998.
6. Principles of Physical Chemistry, 4th Edition
B. R. Puri and L. R. Sharma and M. S. Pathania, S. L. N. Chand & Co., 1987
7. Text Book of Physical Chemistry
P. L. Soni., S. Chand & Co., 1993.
8. Physcial Chemistry
Alberty R. A. and Silbey R. J. John Wiley & Sons, 1992.
9. Physical Chemistry
G. M. Barrow, McGraw Hill, 1986.
10. Physical Chemistry, 3rd Edition
Gibert W. Castellan, Narora Publishing House, 1985.

11. Text Book of Polymer Science
Billmeyer, Dr. F. W. John Wiley & Sons, 1984.
12. Basic Physical Chemistry
Walter J. Moore, Prentice Hall, 1972.

Biochemistry

1. Concise Text Book of Biochemistry
T. N. Pattabhiraman, All India Publishers, 2000.
2. Biochemistry
A. L. Lehningeret. al., CBS, 2000.
3. A Text Book of Biochemistry
A. V. S. S. Rama Rao, UBSPD, 1998.
4. Biochemistry
P. C. Champe and R. A. Harvey, J. B. Lipincott& Co, 1982.
5. Fundamentals of Biochemistry
J. L. Jain, S. Chand & Co., 1983.
6. Biochemistry
COSIP-ULP, Bangalore University, 1981.
7. Outlines of Biochemistry
Conn E. E and Stumpf P. K., John Wiley & Sons, 1978.
8. General Biochemistry
Weil J. H., Wiley Eastern
9. BiochemistryCampbell M. K., Harcourt Brace & Co.

Chemistry Practicals for B. Sc., Course

I Semester: Practical 1 (General Chemistry) 3 hours per week

1. Calibration of glass wares: (i) Pipette (ii) Burette (iii) Volumetric flask
2. Estimation of potassium permanganate using standard sodium oxalate solution.
3. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution with potassium ferricyanide as an external indicator.
4. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution with diphenyl amine as an internal indicator. (Change to ferroin indicator?)
5. Estimation of sodium thiosulphate using standard potassium dichromate solution.
6. Estimation of iodine using sodium thiosulphate and standard potassium dichromate solution.
7. Determination of the percentage of available chlorine in the given sample of bleaching powder.
8. Determination of percentage of manganese dioxide from pyrolusite ore.
9. Estimation of chloride by Mohr's method (using potassium chromate as an adsorption indicator).
10. Estimation of chloride by Volhard's method.
11. Estimation of ferrous and ferric iron in a given mixture using standard potassium dichromate solution.
12. Estimation of nitrogen in an ammonium salt using sodium hydroxide solution and standard oxalic acid.
13. Estimation of carbonate and bicarbonate in a given mixture.

Note: ***Standard solutions to be prepared for experiments 2 to 6***.

II Semester: Practical II (Physical Chemistry) 3 hours per week

1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
2. Determination of percentage composition of a binary liquid mixture by viscosity method.
3. Determination of molar mass of polymer by viscosity method.
4. Determination of the density using specific gravity bottle and surface tension of a liquid using Stalagmometer.
5. Determination of molar mass of a non-electrolyte by Walker-Lumsden method.
6. Determination of degree of dissociation of an electrolyte by ebullioscopic method.
7. Determination of transition temperature of a salt hydrate by thermometric method.
8. Determination of distribution coefficient of acetic acid between water and butanol.
9. Determination of distribution coefficient of benzoic acid between water and toluene.
10. Effect of surfactants on the surface tension of water (Stock solution to be given).

III Semester: Practical III (Organic Chemistry) 3 hours per week

Preparation and purification of organic compounds

1. Recrystallisation and determination of melting point of solids (mixed melting point determination and its importance may be mentioned).
2. Simple distillation and determination of boiling point of liquids.
3. Purification of solids by sublimation.

One stage preparation

(Preparation, recrystallization and melting point determination of the recrystallised sample)

4. Preparation of aspirin from salicylic acid.
   (*Note: Acetic anhydride is to be prepared freshly by distilling acetyl chloride and sodium acetate mixture*).
5. Preparation of paracetamol from *p*-aminophenol.
6. Preparation of dibenzalacetone from benzaldehyde (using acetone-alcoholic sodium hydroxide).
7. Preparation of *p*-aminobenzoic acid from *p*-nitrobenzoic acid.
8. Preparation of *m*-dintrobenzene from nitrobenzene.
9. Preparation of benzoic acid from benzaldehyde.

Two stage preparations

10. Preparation of *p*-bromoaniline from acetanilide.
11. Preparation of *p*-nitroaniline from acetanilide.
12. Preparation of *m*-nitrobenzoic acid from methyl benzoate.
13. Preparation of methyl orange/methyl red by diazotization and coupling.

Chromatography

14. **Paper chromatography**: Extraction of spinach (using 1 : 1 alcohol and Whatmann filter paper)
15. **Thin layer chromatography**: Separation of green leaf pigments/separation of a mixture of two organic compounds.
16. **Column chromatography**: Separation of a mixture of two organic compounds

IV Semester: Practical IV (Inorganic Chemistry) 3 hours per week

1. Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals).
2. Separation of metal ions (Cu^{2+}, Co^{2+}, Ni^{2+}, Fe^{2+})using paper chromatography and calculation of R_f values (To be performed by the students)
3. Separation of Mg(II) and Fe(II) by solvent extraction technique.
4. Effluent analysis.

V Semester: Practical V (Organic Chemistry) 3 hours per week

1. Organic qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant. Preparation and characterization of a suitable derivative.
2. Isolation of lycopene from tomatoes.
3. Isolation of caffeine from tea leaves.

V Semester: Practical VI (Physical Chemistry) 3 hours per week

1. Determination of velocity constant for acid catalysed hydrolysis of methyl acetate and determination of energy of activation.
2. Determination of velocity constant for the saponification of ethyl acetate ($a = b$).
3. The study of kinetics of potassium persulphate and potassium iodide colorimetrically.
4. Determination of equivalent conductivity of 0.1 N sodium chloride and verification of DHO equation.
5. Determination of dissociation constant of monochloroacetic acid by conductivity method.
6. Conductometric titration of hydrochloric acid with sodium hydroxide.
7. Potentiometric titration of potassium dichromate with ferrous ammonium sulphate.
8. Determination of Critical Micellar Concentration (CMC) by conductivity method.
9. Determination of pK_a of a weak acid by pH metric method.
10. To construct the phase diagram of two component system (Ex. diphenylamine-benzophenone) by cooling curve method.
11. Determination of percentage of sodium chloride by miscibility temperature method.
12. Estimation of Cu^{2+} colorimetrically and verification of Beer-Lambert's law.
13. Determination of Oxidation and Reduction potential of $K_4Fe(CN)_6/K_3Fe(CN)_6$ system by cyclic voltammetry.

VI Semester: Practical VII (Inorganic Chemistry) 3 hours per week

1. Estimation of percentage of iron in haematite using bariumdiphenylamine sulphonateas an internal indicator.
2. Estimation of calcium in lime stone.
3. Estimation of copper in brass.
4. Estimation of zinc using EDTA.
5. Estimation of total hardness of water using EDTA.
6. Gravimetric estimation of barium as barium sulphate.
7. Gravimetric estimation of nickel as nickel dimethyl glyoximate.
8. Preparation of cuprammoniumsulphate and determination of λ_{max} and hence CFSE.
9. Preparation of sodium trioxalatoferrate (III) and estimation of iron.
10. Estimation of nickel using EDTA and standard zinc sulphate.
11. Preparation of ferrous oxalate and its analysis (both iron and oxalate).

VI Semester: Practical VIII (Biochemistry) 3 hours per week

1. Preparation of buffers and determination of their pH values using pH meter.
2. Estimation of reducing sugars by Hegdorn-Jensen method.
3. Estimation of lactose in milk by Nelson-Somyogi's method.
4. Estimation of creatinine by Jaffe's method.
5. Estimation of inorganic phosphate by Fiske-Subbarow method.
6. Estimation of total reducing sugars by DNS (dinitrosalicylic acid) method.
7. Isolation of lactose and casein from milk and estimation of lactose by colorimetric method.
8. Estimation of α-amino acids using ninhydrin by colorimetric method.
9. Determination of blood group.
10. Separation of α-amino acids by paper chromatography.
11. Isolation of DNA from onions.
12. Estimation of cholesterol by colorimetric method.

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Proposed Syllabus for B.Sc. Mathematics paper for 6 semesters under Choice Based Credit Scheme (CBCS)

Effective from the academic year 2014-2015

Department of Mathematics
Bangalore University

BANGALORE UNIVERSITY
DEPARTMENT OF MATHEMATICS

Date: 13-6-2014

PROCEEDINGS OF THE BOS (UG) IN MATHEMATICS

The meeting of the Board of Studies in UG Mathematics for the year 2014-15 was held on Friday, June 13, 2014 at 2-00 p.m. in the chambers of the Chairman. The following members attended the meeting:

1. Dr. Pradeep G. Siddheshwar	Chairman	
2. Dr. Gayatri Nataraj	Member	
3. Dr. Sudhakar H. R.	Member	
4. Shri Ashwartha Reddy M.	Member	
5. Shri Thajmull Pasha B.	Member	ABSENT
6. Shri Ramakrishnappa V.	Member	
7. Shri Narasimhamurthy A. G.	Member	
8. Smt. Madhulatha Moses	Member	
9. Shri Sethuram H. R.	Member	
10. Dr. S. Pranesh	External Member	
11. Shri Vittal V. Kulkarni	External Member	13/6/14

Agenda and resolution:

1. Discussion on the syllabus of mathematics papers of B.Sc. course

   The BOS had a discussion on the draft syllabus for three years of B.Sc. (six semesters) prepared by teachers and approved the same with a practical component (mathematics practicals with FOSS tools for programming). Further, the BOS authorizes the BOS (PG - mathematics) to deliberate and decide on the contents of the syllabus of B.Sc.(Honours) which is the same as that of I M.Sc. (Mathematics).
   The BOS also resolved to change the list of practical experiments each year.

2. Panel of examiners of UG (Mathematics) and UG (Engineering Mathematics).

   The committee approved the updated panel of examiners of the two UG courses.

CHAIRMAN

Copy to:
1. The PS to the Registrar, Bangalore University, Bangalore.

2. The PS to the Vice-chancellor, Bangalore University, Bangalore.

Structure of B.Sc. / B.Sc.(Hons.) – Mathematics papers

Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
				IA	Exam	Total	
I Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
II Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
III Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
IV Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
V Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1
VI Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1

Note: The structure of the syllabus of mathematics paper of B. Sc. (Hons.) is included in the structure of M.Sc. (Mathematics) syllabus.

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

Mission

- Improve retention of mathematical concepts in the student.
- To develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer.
- To make the learning process student-friendly by having a shift in focus in mathematical teaching, especially in the mathematical learning environment.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- Propagate FOSS (Free and open source software) tools amongst students and teachers as per vision document of National Mission for Education.
- To set up a mathematics laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To orient students towards relating Mathematics to applications.

Vision

- To remedy Math phobia through authentic learning based on hands-on experience with computers.
- To foster experimental, problem-oriented and discovery learning of mathematics.
- To show that ICT can be a panacea for quality and efficient education when properly integrated and accepted.
- To prove that the activity-centered mathematics laboratory places the student in a problem solving situation and then through self exploration and discovery habituates the student into providing a solution to the problem based on his or her experience, needs, and interests.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To provide scope for greater involvement of both the mind and the hand which facilitates cognition.
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers in understanding and learning FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open source softwares like scilab, maxima, octave, geogebraand others.

(website: http://spoken-tutorial.org ; email: contact@spoken-tutorial.org ; info@spokentutorial.org)

NEW SYLLABUS
FIRSTSEMESTER
MATHEMATICS – I

(4 lecture hours per week+3 hours of practicals/week per batch of not more than 10 students)

(56 HOURS)

THEORY

1. ALGEBRA - I

Matrices

Elementary row and column transformations(operations), equivalent matrices, theorems on it. Row- reduced echelon form, Normal form of a matrix , Rank of a matrix, Problems.

Homogeneous and Non – Homogeneous systems of *m* linear equations in *n* unknowns consistency criterion – criterion for uniqueness of solutions. Solution of the same by elimination method.

Eigenvalues and Eigenvectors of a square matrix of order 2 and 3,standard properties, Cayley-Hamilton theorem (with proof). Finding A^{-1}, A^{-2} and A^2, A^3, A^4

(14 lecture hours)

2. CALCULUS - I

a) Differential Calculus

Successive Differentiation - n^{th} derivatives of the functions: e^{ax} , $(ax + b)^n$, log(ax + b), sin(ax + b) , cos(ax + b), $e^{ax}sin(bx+ c)$, $e^{ax}\cos(bx + c)$ – Problems

Leibnitz theorem (with proof) and its applications.

Partial differentiation –Function of two and three variables - First and higher derivatives - Homogeneous functions – derivatives- Euler's theorem and its extension (with proof) - Total derivative and differential - Differentiation of implicit functions and composite functions – Problems - Jacobians – Properties of Jacobians problems.

b) Integral Calculus

Reduction formulae for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \cot^n x\,dx$, $\int \sec^n x\,dx$, $\int \operatorname{cosec}^n x\,dx$, $\int \sin^m x \cos^n x\,dx$, with definite limit. Differentiation under integral sign by Leibnitz rule.

(28 lecture hours)

3.GEOMETRY

Analytical Geometry Of Three Dimensions

Recapitulation of elements of three dimensional geometry - Different forms of equations of straight line and plane.

Angle between two planes - Line of intersection of two planes - Plane coaxal with given planes - Planes bisecting the angle between two planes - Angle between a line and a plane - Coplanarity of two lines - Shortest distance between two lines.

Equation of the sphere in general and standard forms - equation of a sphere with given ends of a diameter.Tangent plane to a sphere, orthogonallity of spheres.

Standard equations of right circular cone and right circular cylinder.

(14 lecture hours)

Note: All the derivations (book works) must be through vector methods with reduction to corresponding Cartesian equivalents.

Suggested distribution of lecture hours

1.Matrices: 1 hour perweek
2.Differential Calculus and Integral Calculus: 2 hours perweek
3. Analytic Geometry of three dimensions: 1 hour perweek.

Text Books/open source materials

1. Shanti Narayan and P K Mittal , Text book of *Matrices*, 5th edition, New Delhi, S Chand and Co. Pvt. Ltd.,2013.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. Shanthi Narayan and P K Mittal, *Analytical Solid Geometry*. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

Reference Books

1. B S Vatssa, *Theory of Matrices*, New Delhi: New Age International Publishers, 2005.
2. A R Vashista, Matrices, Krishna Prakashana Mandir, 2003.
3. G B Thomasand R L Finney, *Calculus and analytical geometry,Addison Wesley, 1995.*

4. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
5. N P Bali, *Differential Calculus*, India: Laxmi Publications (P) Ltd.., 2010.
6. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., vol. I & II1996.
7. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
8. S.P.Mahajan & Ajay Aggarwal, *Comprehensive Solid Geometry* , 1st ed.: Anmol Publications , 2000.

Useful web links:

1. http://www.cs.columbia.edu/~zeph/3203s04/lectures.html
2. http://home.scarlet.be/math/matr.htm
3. http://www.themathpage.com/
4. http://www.abstractmath.org/
5. http://ocw.mit.edu/courses/mathematics/
6. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
7. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
8. http://mathworld.wolfram.com/Calculus.html
9. http://ocw.mit.edu/courses/mathematics/
10. http://www.univie.ac.at/future.media/moe/galerie.html
11. http://mathworld.wolfram.com/AnalyticGeometry.html

PRACTICALS – I

Mathematics practicals with F*ree* and O*pen*S*ource* S*oftware* (FOSS) tools for computer programs
(3 hours/ weekper batch of not more than 10 students)

LIST OF PROBLEMS

1. Introduction to Scilab and commands connected with matrices.
2. Computations with matrices.
3. Row reduced echelon form and normal form.
4. Establishing consistency or otherwise and solving system of linear equations.
5. Introduction to Maxima and commands for derivatives and n^{th} derivatives.
6. Scilab and Maxima commands for plotting functions.
7. n^{th} derivative without Leibnitz rule.
8. n^{th} derivative with Leibnitz rule.
9. Obtaining partial derivative of some standard functions
10. Verification of Euler's theorem, its extension and Jacobian.
11. Maxima commands for reduction formula with or without limits.

12. Implementing vector form of line.
13. Implementing vector form of plane.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

SECOND SEMESTER
MATHEMATICS – II

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

(56 HOURS)

THEORY

1. ALGEBRA - II

Group Theory

Binary operation, algebraic structure-problems on finding identity and inverse. Definitions of semigroup and group, abelian group – problems on finite and infinite groups. Properties of group with proof – standard problems on groups – A finite semigroup with both the cancellation laws is a group – Any group of order less than five is abelian – permutation groups.

Subgroups- theorems on subgroups (with proof)- problems.

(14 lecture hours)

2. CALCULUS - II

a) Differential Calculus

Polar coordinates - Angle between the radius vector and the tangent - Angle of intersection of curves (polar form) polar sub-tangent and polar subnormal- perpendicular from pole on the tangent - Pedal equations. Derivative of an arc in Cartesian, parametric and polar forms.

Curvature of plane curves - formula for radius of curvature in Cartesian, parametric, polar and pedal forms - centre of curvature - evolutes. Singular points – Asymptotes – Envelopes. General rules for tracing of curves.

b) Integral Calculus

Applications of Integral Calculus: computation of length of arc, plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and Polar forms.

(28 lecture hours)

4.DIFFERENTIAL EQUATIONS – I

Solutions of ordinary differential equations of first order and first degree:

(i) Linear equations, Bernoulli equation and those reducible to these.

(ii) Exact equations(excluding reducible to Exact)

Equations of first order and higher degree – non linear first order, higher degree – (Mention) solvable for p - solvable for y - solvable for x - Clairaut's equation -

singular solution - Geometric meaning.Orthogonal trajectories in Cartesian and polar forms.

(14 lecture hours)

Suggested distribution of lecture hours

1. Algebra-II (Group theory) : 1 hour / week
2. Calculus-II (Differential calculus & Integral Calculus): 2 hours / week.
3. Differential Equations-I: 1 hour / week.

Text Books/open source materials

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, New ed. New Delhi, India: Laxmi Publications (P) Ltd.., 2010.
8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., vol. I & II, 1996.

9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of AdvancedCalculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
12. F Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
13. S Narayanan and T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Private Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
6. http://mathworld.wolfram.com/Calculus.html
7. http://ocw.mit.edu/courses/mathematics/
8. http://www.univie.ac.at/future.media/moe/galerie.html
9. http://tutorial.math.lamar.edu/classes/de/de.aspx
10. http://www.sosmath.com/diffeq/diffeq.html
11. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –II

Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Creating a Scilab program (simple examples).
2. Creating a Maxima program (simple examples).
3. i. Verifying whether given operator is binary or not.
   ii. To find identity element of a group.
   iii.To find inverse element of a group.
4. Finding all possible subgroups of a finite group.
5. Plotting of standard Cartesian curves using Scilab/Maxima.
6. Plotting of standard Cartesian curves using Scilab/Maxima.

7. Plotting of standard Polar curves using Scilab/Maxima.
8. Plotting of standard parametric curves using Scilab/Maxima.
9. Scilab/Maxima programs for area and volume.
10. Solution of Differential equation using Scilab/Maxima and plotting the solution-I.
11. Solution of Differential equation using Scilab/Maxima and plotting the solution-II.
12. Solution of Differential equation using Scilab/Maxima and plotting the solution-III.
13. Solution of Differential equation using Scilab/Maxima and plotting the solution-IV.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

THIRD SEMESTER
MATHEMATICS-III

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

(56 HOURS)

THEORY

1. ALGEBRA - III

Groups

Order of an element of a group – properties related to order of an element- subgroup generated by an element of a group –coset decomposition of a group, Cyclic groups- properties- modulo relation- index of a group –Lagrange's theorem- consequences.

(14 lecture hours)

2. ANALYSIS – I

a) Sequences Of Real Numbers

Definition of a sequences-Bounded sequences- limit of a sequences- convergent, divergent and oscillatory sequences- Monotonic sequences and their properties- Cauchy's criterion.

b) Series Of Real Numbers

Definition of convergence, divergence and oscillation of series -properties of Convergence series - properties of series of positive terms – Geometric series Tests for convergence of series -p- series - comparison of series Cauchy's root Test -D Alembert's test. Raabe's test ,- Absolute and conditional convergence-D' Alembert test for absolute convergence - Alternating series - Leibnitz test.

Summation of binomial, exponential and logarithmic series.(28 lecture hours)

3. CALCULUS - III

Differential Calculus

Recapitulation of Equivalence Class and partition of a set. Definition of the limit of a function in ε-δ form –continuity- types of discontinuities. Properties of continuous function on a closed interval (boundedness, attainment of bounds and taking every value between bounds). Differentiability -Differentiability implies Continuity – Converse not true. Rolle's Theorem- Lagrange's and Cauchy's First Mean Value Theorem (Lagrange's form) - Maclaurin's expansion. Evaluation of limits by L' Hospital's rule (14 lecture hours)

Suggested distribution of lecture hours

1. Algebra – III (Groups): 1 hour / week.
2. Analysis-I (sequences of real numbers and series of real numbers):2 hours /week
3. Calculus - III(differential calculus): 1 hour / week.

Text Books/open source materials

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.
3. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
4. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. Richard R Goldberg, *Methods of Real Analysis*, Indian ed. New Delhi, India: Oxford and IBH Publishing Co., 1970.

6. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
7. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
8. N P Bali, *Differential Calculus*, New ed. New Delhi, India: Laxmi Publications (P) Ltd.., 2010.
9. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., vol. I & II1996.
10. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
11. E Spiegel, *Schaum's Outline of AdvancedCalculus*, 5th ed. USA: Mc. Graw Hill., 2009.

Usefulweb links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://www.math.unl.edu/~webnotes/contents/chapters.htm
5. http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html
6. http://web01.shu.edu/projects/reals/index.html
7. http://www.mathcs.org/analysis/reals/index.html
8. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
9. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
10. http://mathworld.wolfram.com/Calculus.html
11. http://ocw.mit.edu/courses/mathematics/

PRACTICALS –III

Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Examples to verify Lagrange's theorem.
2. Examples for finding left and right coset and finding the index of a group.
3. Illustration of convergent, divergent and oscillatory sequences using Scilab/Maxima.
4. Illustration of convergent, divergent and oscillatory series using Scilab/Maxima.
5. Scilab/Maxima programs to find the sum of the series and its radius of convergence.
6. Using Cauchy's criterion to determine convergence of a sequence (simple examples).
7. Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of a series.

8. Testing the convergence of binomial, exponential and logarithmic series and finding the sum.
9. Scilab/Maxima programs to illustrate continuity of a function.
10. Scilab/Maxima programs to illustrate differentiability of a function and unequal left hand and right hand limits for discontinuous functions.
11. Scilab/Maxima programs to verify Rolle's theorem and Lagrange's theorem.
12. Scilab/Maxima programs to verify Cauchy's mean value theorem and finding Taylor's theorem for a given function.
13. Evaluation of limits by L'Hospital's rule using Scilab/Maxima.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FOURTH SEMESTER

MATHEMATICS - IV

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

(56 HOURS)

THEORY

1. ALGEBRA –IV

Groups

Normal subgroups-examples and problems –Quotient group-Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the Kernel-Fundamental theorem of homomorphism- properties related to isomorphism-Permutation group-Cayley's theorem.

(14 lecture hours)

2. ANALYSIS -II

Fourier Series

Trigonometric Fourier series of functions with period 2π and period $2L$ – Half range Cosine and sine series.

(9 lecture hours)

3. CALCULUS - IV

Differential Calculus

Continuity and differentiability of a function of two and three variables – Taylor's Theorem and expansion of functions of two variables- Maxima and Minima of functions Of two variables. Method of Lagrange multipliers. (9 lecture hours)

4. MATHEMATICAL METHODS - I

Definition and basic properties Laplace transform of some common functions and Standard results –Laplace transform of periodic functions- Laplace transforms ,of derivatives And the integral of function- Laplace transforms, Heaviside function

convolution theorem (statement only) Inverse Laplace transforms.

(10 lecture hours)

5. DIFFERENTIAL EQUATIONS –II

Second and higher order ordinary linear differential equations with constant Coefficients- complementary function- particular integrals (standard types) Cauchy-Euler differential equation. Simultaneous linear differential equations (two variables) with constant coefficients. Solutions of second order ordinary linear differential equations with variables coefficients by the following methods.

(i). When a part of complementary function is given
(ii). Changing the independent variable
(iii). Changing the dependent variable
(iv). Variation of parameters
(v). Conditions for exactness and the solution when the equation is exact.

(14 lecture hours)

Suggested distribution of lecture hours

1. Algebra – IV (Rings ,Fields and Integal domains): 1 hour / week
2. Analysis – II (Fourier series), Calculus-IV (Differential Calculus) and Mathematical methods-I (Laplace transform): 2 hours / week.
3. Differential Equations II: 1 hour / week.

Text Books/open source materials

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
4. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.
5. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
6. www.scilab.org.
7. **wxmaxima**.sourceforge.net
8. www.geogebra.org

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.

2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, Laxmi Publications (P) Ltd.., 2010.
8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., vol. I & II1996.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of AdvancedCalculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. Raisinghania M.D., *Laplace and Fourier Transforms*. New Delhi, India: S. Chand and Co. Ltd. , 1995.
12. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.
13. FAyres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
14. S Narayanan and T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Private Ltd., 1981.
15. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://www.fourier-series.com/
4. http://mathworld.wolfram.com/
5. http://www.princeton.edu/~rvdb
6. http://www.zweigmedia.com/RealWorld/Summary4.html
7. http://ocw.mit.edu/courses/mathematics/
8. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
9. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
10. http://mathworld.wolfram.com/Calculus.html
11. http://ocw.mit.edu/courses/mathematics/
12. http://www.univie.ac.at/future.media/moe/galerie.html
13. http://tutorial.math.lamar.edu/classes/de/de.aspx
14. http://www.sosmath.com/diffeq/diffeq.html
15. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –IV
Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Illustrating homomorphism and isomorphism of groups.
2. Verification of Normality of a given subgroup.
3. Verifying Cayley's theorem and isomorphism theorems.
4. To plot periodic functions with period 2π and 2L.
5. To find full range trigonometric Fourier series of some simple functions with period 2π and 2L.
6. Plotting of functions in half-range and including their even and odd extensions.
7. To find the half-range sine and cosine series of simple functions.
8. Finding maxima/minima of functions of two variables.
9. Finding the Laplace transforms of some standard functions.
10. Finding the inverse Laplace transform of simple functions.
11. Implementing Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficient.
12. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations.
13. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER

MATHEMATICS V

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

THEORY(42 hours)

1. ALGEBRA - IV

Rings, Integral Domains, Fields

Rings, Types of Rings properties of rings – Rings of integers modulo n – Subrings – Ideals ,Principal, Prime and Maximal ideals in a commutative ring – examples and standard properties following the definition – Homomorphism, Isomorphism – Properties – Quotient rings – Integral Domain- Fields - properties following the definition – Fundamental Theorem of Homomorphism of Rings - Every field is an integral domain – Every finite integral domain is a field – Problems.

(14 lecture hours)

2. CALCULUS - V

Differential Calculus Of Scalar And Vector Fields

Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field – divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems.

(14 lecture hours)

3. NUMERICAL METHODS - I

Finite differences – Definition and properties of $\Delta, \nabla, \delta, \mu$ and E, the relation between them – The nth differences of a polynomial, Factorial notations, separation of symbols, divided differences and related theorems.

Newton –Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals - Inverse interpolation.

Numerical Integration: Quadrature formula – Trapezoidal rule -Simpon's 1/3 and 3/8 rule(without proofs) and problems.

(14 lecture hours)

Suggested distribution of lecture hours.

1. Algebra IV: 1 hour /week.
2. Calculus-V (Differential calculus of scalar and vector fields): 1 hours/week
3. Numerical Methods I : 1 hours/week

Text Books/open source materials

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.
3. M D Raisinghania, *Vector calculus*,S Chand Co. Pvt. Ltd., 2013.
4. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.

2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
6. B Spain,*Vector Analysis* , ELBS, 1994.
7. D E Bournesand, P C Kendall, *Vector Analysis,* ELBS, 1996.
8. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India,2012.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
6. http://mathworld.wolfram.com/Calculus.html
7. http://www.univie.ac.at/future.media/moe/galerie.html
8. http://www.math.gatech.edu/~harrell/calc/
9. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
10. http://math.fullerton.edu/mathews/numerical.html
11. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –V

Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Examples on different types of rings.
2. Examples on integral domains and fields.
3. Examples on subrings, ideals and subrings which are not ideals.
4. Homomorphism and isomorphism of rings- illustrative examples.
5. To demonstrate the physical interpretation of gradient, divergence and curl.
6. Writing gradient, divergence, curl and Laplacian in cylindrical coordinates.
7. Writing gradient, divergence, curl and Laplacian in spherical coordinates.
8. Using cyclic notations to derive different vector identities.
9. Using cyclic notations to derive some more vector identities.
10. Scilab/Maxima programs on Interpolations with equal intervals.
11. Scilab/Maxima programs on Interpolations with unequal intervals.

12. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{1}{3}^{rd}$ rule.

13. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{3}{8}^{th}$ rule.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER
MATHEMATICS – VI

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 10 students)

(42 HOURS)

THEORY

1. MATHEMATICAL METHODS - II

Calculus Of Variation

Variation of a function $f = f(x, y, y')$ – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems.

(14 Lecture hours)

2. CALCULUS – VI

a). Line And Multiple Integrals

Definition of line integral and basic properties examples evaluation of line integrals.

Definition of double integral – its conversion to iterated integrals .Evaluation of double integrals by change of order of integration and by change of variables – computation of plane and surface areas ,volume underneath a surface and volume of revolution using double integrals.

Definitionof triple integral and evaluation – change of variables – volume as a triple integral .

(18lecture hours)

b). Integral Theorems

Green's theorem (with proof) - Direct consequences of the theorem.The Divergence theorem (with proof) - Direct consequences of the theorem.The Stokes' theorem (with proof) - Direct consequences of the theorem.

(10 lecture hours)

Suggested distribution of lecture hours

1. Mathematical Methods II (Calculus of variation): 1 hour /week.
2. Calculus VI (Line and Multiple Integrals and Integral theorems): 2 hours/week

Text Books/open source materials

1. R Weinstock,*Calculus of Variation*, Dover, 1970.
2. M. D. Raisinghania, *Vector Calculus,* S Chand Co. Pvt. Ltd., 2013.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. F B Hildebrand, *Methods in Applied Mathematics,*
2. B Spain,*Vector Analysis* , ELBS, 1994.
3. D E Bournesand, P C Kendall, *Vector Analysis,* ELBS, 1996.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
3. http://mathworld.wolfram.com/Calculus.html
4. http://www.univie.ac.at/future.media/moe/galerie.html
5. http://www.math.gatech.edu/~harrell/calc/

PRACTICALS –VI

Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Example on Euler's equation in full form.
2. Example on particular forms of Euler's equation.
3. Examples on minimum surface of revolution and Brachistochrome problem.
4. Examples on Isoperimetric problems.
5. Evaluation of the line integral with constant limits.
6. Evaluation of the double integral with constant limits.
7. Evaluation of the triple integral with constant limits.
8. Evaluation of the line integral with variable limits.
9. Evaluation of the double integral with variable limits.
10. Evaluation of the triple integral with variable limits.
11. Verifying Green's theorem.
12. Verifying Gauss divergence theorem.
13. Verifying Stokes' theorem

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

SIXTH SEMESTER
MATHEMATICS - VII

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

(42 HOURS)

THEORY

1. ALGEBRA –V

Linear Algebra

Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace –linear span of a set - linear combination – linear independent and dependent subsets – Basis and dimensions– Standard properties – Examples illustrating concepts and results.

Linear transformations – properties – matrix of a linear transformation – change of basis – range and kernel – rank and nullity – Rank – Nullity theorem – Non-singular and singular linear transformations - Standard properties – Examples.

(14 lecture hours)

2. DIFFERENTIAL EQUATIONS III

a). Orthogonal Curvilinear Coordinates

Definition of orthogonal curvilinear coordinates. Fundamental vectors or base vectors, Scale factors or material factors - quadratic differential form. Spherical curvilinear system : Cartesian, Cylindrical – conversion of Cylindrical to orthogonal Spherical polar coordinates. Theorem: The Spherical coordinate system is orthogonal curvilinear coordinate system. (without proof) No problems on conversions of one system to another.

b). Partial Differential Equations

Total differential equations-Necessary condition for the equation $Pdx+ Qdy+Rdz= 0$ to be integrable-Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

Formation of partial differential equation .Equations of First Order Lagrange's linear equation – Charpit's method, Standard types of first order non-linear partial differential equation (By known substitution).

Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral

Solution of one – dimensional heat equations, Solution of one – dimensional wave equations using Fourier series.

(28 lecture hours)

Suggested distribution of lecture hours:

1. Algebra-V (Linear Algebra) : 1 hours / week.
2. Differential Equations III: 2 hours / week

Text Books/open source materials

1. Krishnamoorty V K and Mainra V P and Arora J L, *An Introduction to Linear Algebra*, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
2. M. D. Raisinghania, *Vector Calculus,* S Chand Co. Pvt. Ltd., 2013.
3. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
4. www.scilab.org
5. **wxmaxima**.sourceforge.net
6. www.geogebra.org

Reference Books

1. G Strang, MIT open courseware (http://ocw.mit.edu/courses).
2. B Spain, *Vector Analysis* , ELBS, 1994.
3. D E Bournes and, P C Kendall, *Vector Analysis,* ELBS, 1996.
4. Frank Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 1972.
5. GF Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
6. S Narayanan & T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Private Ltd., 1981.
7. I N Sneddon, *Elements of Partial Differential Equations*, 3rd ed.: Mc. Graw Hill., 1980.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://mathworld.wolfram.com/Calculus.html
3. http://www.math.gatech.edu/~harrell/calc/
4. http://tutorial.math.lamar.edu/classes/de/de.aspx
5. http://www.sosmath.com/diffeq/diffeq.html
6. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –VII

Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. i. Vector space, subspace – illustrative examples.
   ii. Expressing a vector as a linear combination of given set of vectors.
   iii. Examples on linear dependence and independence of vectors.
2. i. Basis and Dimension – illustrative examples.
   ii. Verifying whether a given transformation is linear.

3. i. Finding matrix of a linear transformation.
   ii. Problems on rank and nullity.
4. Plotting of cylinder and cone using orthogonal curvilinear coordinates.
5. Plotting of sphere using orthogonal curvilinear coordinates.
6. Solutions to the problems on total and simultaneous differential equations.
7. Solutions to the problems on different types of Partial differential equations.
8. Solving second order linear partial differential equations in two variables with constant coefficient.
9. Solving some more second order linear partial differential equations in two variables with constant coefficient.
10. Solution of one dimensional heat equation using Fourier series with Dirichlet condition.
11. Solution of one dimensional heat equation using Fourier series with Neumann condition.
12. Solution of one dimensional wave equation using Fourier series with Dirichlet condition.
13. Solution of one dimensional wave equation using Fourier series with Neumann condition.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

SIXTH SEMESTER
MATHEMATICS - VIII

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 students)

(42 HOURS)

THEORY

1. ANALYSIS - III

Complex Analysis

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula- $e^{i\theta} = \cos\theta + i\sin\theta$.Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function Cauchy-Riemann equations in Cartesian and Polar forms-Sufficiency conditions for analyticity(Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.

Complex integration-the complex integration –properties-problems.Cauchy's Integral theorem-proof using Green's theorem- direct consequences.Cauchy's Integral formula with proof-Cauchy's generalised formula for the derivatives with proof and

applications for evaluation of simple line integrals - Cauchy's inequality with proof – Liouville's theorem with proof. Fundamental theorem of algebra with proof.

Transformations – conformal transformation – some elementary transformations namely Translation,rotation,magnification and inversion - examples.

The bilinear transformation (B.T.)-cross ratio-invariant points of a B.T.-properties-

(i) B.T. sets up a one to one correspondence between the extended z-plane and the extended w-plane.

(ii) Preservation of cross ratio under a B.T.

(iii) A B.T. transforms circles onto circles or straight lines.

Problems on finding a B.T., and finding images under a B.T.and invariant points of a B.T. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \cosh z$ and $w = e^z$.

(28 lecture hours)

2. NUMERICAL METHODS – II

Numerical solutions of algebraic and Transcendental equations – method of successive bisection - method of false position – Newton-Raphson method. Numerical solutions of non-Homogeneous system of linear algebraic equations in three variables by Jacobi's method and Gauss-Seidel method.Computation of largest Eigen value of a square matrix by power method.

Solutions of initial value problems for ordinary linear first order differential equations by Taylor's series,Euler's and Euler's modified method and Runge-Kutta 4^{th} ordered method.

(14 lecture hours)

Suggested distribution of lecture hours:

1. Analysis-III (Complex Analysis): 2 hours / week.
2. Numerical Methods-II: 1 hour / week

Text Books/open source materials

1. S Shanthinarayan, *Complex Analysis*, S Chand Co. Pvt. Ltd., 2012.
2. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. R V Churchil & J W Brown, *Complex Variables and Applications*, 5th ed.: McGraw Hill Companies., 1989.
2. L V Ahlfors, *Complex Analysis*, 3rd ed.: Mc Graw Hill. , 1979.
3. A R Vashista, *Complex Analysis*, Krishna Prakashana Mandir, 2012.
4. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.

Useful web links:

1. http://www.mathcs.org/analysis/reals/index.html
2. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
3. http://math.fullerton.edu/mathews/numerical.html
4. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –VIII
Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Some problems on Cauchy-Riemann equations (polar form).
2. Implementation of Milne-Thomson method of constructing analytic functions(simple examples).
3. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
4. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates).
5. Illustrating the angle preserving property in a transformation.
6. Illustrating that circles are transformed to circles by a bilinear transformation.
7. Examples connected with Cauchy's integral theorem.
8. Solving algebraic equation (Bisection method).
9. Solving algebraic equation (Regula-Falsiand Newton-Raphson methods).
10. Solving system of equations (Jacobi and Gauss-Seidel methods).
11. Solving for largest eigenvalue by Power method.
12. Solving ordinary differential equation by modified Euler's method.
13. Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.