GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

MINUTES

Of the 17th Meeting of the

VIII ACADEMIC COUNCIL

Day &Date

26th and 29th February, 2016

Time

10.30 a.m.

Venue
COUNCIL HALL
Administration Block

	Botany held on 2/2/2016. The House requested Prof. M. K. Janarthanam, Dean, Faculty of Life Sciences and Environment to draw up codes for the various subjects. **(Action AR-PG)**
D 3.12	**Minutes of the meeting of the Board of Studies in Sociology held on 08/02/2016** The Academic Council decided to defer the item for discussion during the next meeting. **(Action AR-PG)**
D 3.13	**Minutes of the meeting of Board of Studies in Dentistry held on 11/12/2015** The Academic Council approved the minutes of the Board of Studies in Dentistry held on 11/12/2015. **(Action AR-PG)**
D 3.14	**Minutes of the meeting of Board of Studies in Economics held on 04/02/2016** The Academic Council approved the minutes of the Board of Studies in Economics held on 04/02/2016. **(Action AR-PG)**
D 3.15	**Minutes of the meeting of Board of Studies in Philosophy held on 08/02/2016** The Academic Council approved the minutes of the Board of Studies in Philosophy held on 08/02/2016. The Chairperson informed that the books for study indicated at the end of semester II are applicable for Semester I. The hours indicated in the syllabus to be deleted. The Chairperson was requested to draft the syllabi for the second and third year as soon as possible. **(Action AR-PG)**
D 3.16	**Minutes of the meeting of Board of Studies in Microbiology held on 08/02/2016** The Academic Council approved the minutes of the Board of Studies in Microbiology held on 08/02/2016. The Chairperson was requested to finalize the T.Y.B.Sc. syllabus at the earliest. **(Action AR-PG)**
D 3.17	**Minutes of the meeting of Board of Studies in Physics held on 19/01/2016 & 4/02/2016** The Academic Council approved the minutes of the Board of Studies in Physics held on 19/01/2016 and 4/02/2016. **(Action AR-PG)**
D 3.18	**Minutes of the meeting of Board of Studies in Zoology held on 04/02/2016** The Academic Council approved the minutes of the Board of Studies in Zoology held on 4/02/2016 except recommendation at Part A 2) which is to be deleted as it does not come under the purview of the BOS. The Chairperson was requested not to mention the year of publication for the recommended Text/Reference books. **(Action AR-PG)**
D 3.19	**Minutes of the meeting of Ad-hoc Board of Studies in Agriculture held on 11/02/2016** The Academic Council approved the minutes of the meeting of Ad-hoc Board of Studies in Agriculture held on 11/02/2016. The Course structure and the detailed syllabus for the Advance Diploma programme in Agriculture under community

D 3.17 **Minutes of the meeting of Board of Studies in Physics held on 19/01/2016 & 4/02/2016**

Part-A

(i) Recommendations regarding courses of study in the subject or group of subjects at the Under-graduate level.

First meeting - 19th Jan 2016

1. The committees both BOS and the sub-committee decided that each paper would be of 4-credit each.
2. Each paper would comprise of theory and practical/tutorials based on the theory part.
3. In a paper, 3-credits (45-clock hours) would be assigned to theory including examinations and 1-credit (30-clock hours for practical) would be assigned to practical/tutorials including examinations.
4. Papers wherein practical cannot be included would include 1-credit (15-clock hours) tutorials as a replacement to practical.
5. As per the guidelines issued by the University, for B.Sc., there will be 2 Core Courses (CC) every semester for Semester I to IV and 2 Core Courses (CC) and 4 Discipline Specific Elective courses (DSC); each, for Semester V and VI for six units. The three unit will have 1 (CC) and 2 (DSC) each, for Semester V and VI among the ones adopted for six units.
6. The BOS members and the sub-committee members unanimously agreed to adopt the revised syllabus of B.Sc. (Physics) that was formulated passed by BOS at its earlier meeting. It was observed that the syllabus adopted met the requirements suggested by UGC and was in line with the model syllabus given by UGC.
7. The sub-committee was assigned the task of transforming the adopted syllabus for CBCS system by appropriately taking the care of the nomenclature, time allotment, and theory and practical/tutorial component in every paper.
8. The committee found that more skill based papers and a project paper would be added in the currently adopted syllabus after converting the same in to CBCS syllabus.
9. In case of practical it was suggested that the number of students in a batch should be restricted to 12 as suggested by UGC.
10. The BOS committee and the sub- committee decided to hold their second meeting at the Dept. of Physics Goa University on 4th Feb. 2016 at 2.30 p.m. as the assigned task could not be completed in a single meeting.

Second meeting- 4th Feb 2016

1. The BOS committee analyzed and approved the syllabus of the four optional papers namely
   - **i) PHO-303 -Superconductivity and Superfluidity**
   - **ii) PHO-304 -X-Ray Spectroscopy**
   - **iii) PHO-311 –Phase Transitions and Critical Phenomenon**
   - **iv) PHO-312-Spectroscopic Techniques in Condensed Matter Physics**

   proposed for M.Sc. of which i) and ii) are existing papers that are updated with few more additions to their syllabus content and iii) and iv) are new additional papers to the course. (**Detailed Syllabus is attached at Annexure I (refer page no 450)**

2. The BOS committee and the sub-committee scrutinized the undergraduate syllabus in its new CBCS format.
   The BOS committee approved the syllabus after examining the same in detail with the following actions to be initiated in the next meeting of the sub-committee. (**Detailed Syllabus is attached at Appendix B**)

3. Since the time duration allotted was too short the sub-committee although added the following new courses given below to the third year syllabus for including choice component, could not finalize the syllabus for the same.

   PHY-V-D5:Medical Physics
   PHY-V-D6:Computational Physics
   PHY-VI-D5:Physics of Communication
   PHY-VI-D6:Solid State Physics
   PHY-VI-D7: Projects/Experiments in Physics (in lieu of a DSE course) (the student may perform 10 experiments (5 in sem V and 5 in sem VI) with detailed theory from a given list of experiments.)

   It was suggested that the detailed syllabus for these courses could be formulated during the subsequent meeting that could be called later.

Under AOB

Non-agenda item.

Part-B

(i) Scheme of examinations at the under-graduate level
Non-agenda item.

(ii) Scheme of examinations at the post-graduate level
Non-agenda item.

(iii) Panel of examiners for different examinations at post-graduate level
Non-agenda item.

Part-C

(i) Recommendations regarding preparation and publication of selection of reading material in any subject or group of subject and names of persons recommended for appointment to make the selection.
Non-agenda item.

Part-D

i. Recommendations regarding general academic requirements in the Department of University or affiliated Colleges. Non-agenda item.

ii. Recommendations of the Academic Audit Committee and status thereof: **NA**

Part-E

(i) Recommendations of text books for the courses of study at the under-graduate

	level. Non-agenda item. (ii) Recommendations of text books for the courses of study at the post-graduate level. Non-agenda item. **Part-F** (i) The declaration by the Chairman that the minutes were read out by the Chairman at the meeting itself. Sd/- Date: Feb 12th 2016 Signature of the Chairman Place: Goa University **Part-G** Remarks of the Dean (i) The minutes are in order (ii) May be recommended for approval of Academic Council (iii) Special remarks if any Date: Feb 12th 2016 Sd/- Place: Goa University Signature of the Dean (Back to Index)
D 3.18	**Minutes of the meeting of Board of Studies in Zoology held on 04/02/2016** **Part A** **1) Recommendations regarding courses of study in the subject or group of subjects at the undergraduate level:** The restructuring of the existing syllabus of the UG Programme (FY, SY & TY) to fit the proposed CBCS system was done with slight modifications, keeping in view of various aspects, including the local resources, UGC's guidelines and notifications, employability and entrepreneurship. An overall framework of the papers/courses to be taught to the B.Sc. (Zoology) students for all the six semesters was formulated. Detailed syllabi of the first four semesters were also finalized (Annexure I). **2) Recommendations regarding courses of study in the subject or group of subjects at the PG level:** After a thorough discussion regarding the pros and cons of the self financing PGDCG&MLT (P.G. Diploma in Clinical Genetics and Medical Laboratory Techniques) course, the BOS unanimously recommended for keeping the course in abeyance for the academic year 2016-17. 3) **Recommendations regarding courses of study in the subject or group of subjects at the M. Phil / Ph.D. level and the eligibility of admission:** NA

D 3.17 Minutes of the meeting of Board of Studies in Physics held on 19/01/2016 & 4/02/2016

Annexure I

Syllabus of modified (PHO-303, PHO-304) and new (PHO-311 and PHO-312) Optional courses for M.Sc.

i) **PHO-303 -Superconductivity and Superfluidity**
ii) **PHO-304 -X-Ray Spectroscopy**
iii) **PHO-311 –Phase Transitions and Critical Phenomenon**
iv) **PHO-312-Spectroscopic Techniques in Condensed Matter Physics**

Superconductivity and Superfluidity
[PHO-303]

SUPERCONDUCTIVITY: [40]

1. Basic Experimental Aspects [3L+1T]

Introduction, Conduction in metals, Zero-resistivity, Meissner-Ochsenfeld effect, Perfect diamagnetism, Type-I and type-II superconductors, Application of low and high temperature superconductors.

2. Superconducting Materials [6L+2T]

Classical Superconductors:Elemental superconductors, superconducting compounds and alloys, A15 compounds,Chevrel phase compounds and their crystal structure, experimental studies on these materials, Phase diagrams.

High-temperature Superconductors:La-Ba-Cu-0 systems, Y-Ba-Cu-0 systems, Bi-Sr-Ca-Cu-0 systems, Ti-Sr-Ca-Cu-0 systems, superconductivity in rare-earth and actinide compounds, organic superconductors, MgB_2 and Iron Arsenide systems, their crystal structure, experimental studies on these materials, Phase diagrams.

3. Theoretical Aspects [22L+6T]

Phenomenological theories:Thermodynamics of superconducting transition, expressions for critical temperature T_c, critical field H_C London's theory, Pippard non-local theory, Ginzburg-Landau Theory.

Microscopic theory:BCS theory, the electron-phonon interaction, the Cooper pair formation, BCS ground state, Consequences of the BCS theory and comparison with experimental results, Coherence of the BCS ground state and the Meissner-Ochsenfeld effect

Possible Mechanisms of high T_C Superconductors:Hubbard-Model, the Resonance valence Bond (RVB) model, Spin fluctuation model

SUPERFLUIDITY: [20]

1. Superfluid Helium-4 [5L+2T]

Introduction, Classical and quantum fluids, the macroscopic wave function, Superfluid properties of He II, Flow quantization and vortices, the momentum distribution, quasiparticle excitations.

2. Superfluid Helium-3 [5L+2T]

Introduction, The Fermi liquid normal state of ^{3}He, the pairing interaction in liquid ^{3}He, Superfluid phases of ^{3}He.

3. Bose-Einstein Condensates [5L+1T]

Introduction, Bose-Einstein Statistics, Bose-Einstein condensation, BEC in ultra-cold atomic gases.

Reference books:

1. James F. Annett, "Superconductivity, Superfluids and Condensates", Oxford Series in Condensed Matter Physics
2. J.B. Ketterson and S.N. Song, Superconductivity, Cambridge Univ. Press (1999)
3. M. Tinkham, Introduction to Superconductivity, McGraw Hill (1996)
4. C. Kittel, "Introduction to Solid State Physics", Wiley
5. H. Ibach and H. Luth, " Solid State Physics", Springer

X-Ray Spectroscopy
[PHO-304]

1. **Production of X-rays** **[10L+2T]**

Early history and the X-ray tube, Synchrotron Radiation – Properties, Radiated Power, Spectral and angular distribution, Polarization, pulsed time structure, brightness and emittance, Undulator radiation, Wiggler radiation

2. **Scattering of X-Rays** **[12L+3T]**

Thomson and Rayleigh (Coherent) Scattering, Incoherent (Compton) Scattering, X-ray Diffraction and powder analysis techniques, Scattering from liquids and glasses (introduction), Small angle scattering

3. **Photoelectron Spectroscopy** **[10L+2T]**

Photoelectric Effect, Quantum Theory of the Photoelectric Effect, Born Approximation, Shake-up Structure, Experimental Systems, Auger Effect and its Relation to ESCA and X-Ray Spectra, Basic Theory of the Auger, Effect, Detection of Auger Electrons, X-Ray Line Width, Satellites, Low-Energy Satellites, Fluorescence, Measurement of Fluorescence Yield, Autoionization and Internal Conversions

4. **Chemical Shifts in Emission Spectra** **[5L+1T]**

Chemical Shifts of Emission Lines, Level Shift, X-Ray Line Shift, Appearance Potential Spectroscopy, Resonance X-Ray Emission Spectroscopy, Width and Fine Structure of Emission Lines, Anisotropic X-Ray Emission Lines, Nuclear Finite-Size Effects

5. **Absorption Spectra** **[12L+3T]**

Absorption Edge, Transition rate, X-Ray Absorption Near Edge Structure (XANES), Chemical Shifts of Absorption Edges, Extended X-Ray Absorption Fine Structure, History of EXAFS, Basic Theory of EXAFS, EXAFS Experiment, Beamline and optics, Detectors, Data acquisition, treatment and analysis.

Reference Books

1. X-ray Spectrometry : Recent Technological Advances, Edited by K.Tsuji, J.Injuk and R.V.Grieken John Wiley & Sons Ltd. England 2004
2. X-ray Spectroscopy : An Introduction, Bipin Kumar Agarwal Springer –Verlag, 1991
3. X-ray Spectroscopy, L.V. Azaroff McGraw-Hill, New York, 1974
4. X-Rays in Theory and Experiment, Arthur H. Compton and Samuel K. Allison D Van Nostrand Company Inc. 1947
5. Elements of X-ray Diffraction, B.D.CullityAddision Wesley Publishing Company Inc.
6. Introduction to XAFS, Grant Bunker, Cambridge University Press, 2010.
7. Elements of Modern X-ray Physics, Jens Als-Nielsen and Des Mc Morrow, 2nd Edition, Wiley 2011.

Spectroscopic Techniques in Condensed Matter Physics
[PHO-311]

Unit 1:OPTICAL SPECTROSCOPY

1. Introduction [6L+1T]

Electromagnetic radiation, Energy quantisation, light-matter interaction, Absorption and Emission of radiation, Line width and its broadening mechanisms, natural and Doppler broadening, Optical measurements: noise statistics, photon detectors and cameras, UV-VIS spectroscopy, Instrumentation

2. Luminescence Spectroscopy [6L+1T]

Optical absorption: Free carrier absorption-optical transition between bands-direct, and indirect-excitons, principles of luminescence, Frank-Condon principle, types of luminescence, instrumentation, excitation and emission spectra, decay mechanism, Fluorescence, Phosphorescence, lifetime measurements, luminescence in different types of phosphors, sensitized luminescence, thermo luminescence and methods of analysis, models for luminescence, Phosphors for different applications.

Unit 2:ATOMIC AND MOLECULAR SPECTROSCOPY

1. Electronic spectroscopy [7L+1T]

One-electron and two-electron atoms: spectrum of hydrogen, helium and alkali atoms; Many electron atoms: central field approximation, Thomas-Fermi model, Slater determinant, HarteeFock and self-consistent field methods, Hund's rule, L-S and j-j coupling, Equivalent and 1on-equivalent electrons, Spectroscopic terms, Lande interval rule; Interaction with Electromagnetic fields: Zeeman, Paschen Back and Stark effects, electronic spin resonance.

Hyperfine structure and isotope shift, selection rules; Lamb shift, Spontaneous and stimulated emissions, Einstein coefficients, Introduction to lasers and laser spectroscopy

2. Molecular Spectroscopy [7L+1T]

Types of Molecules, Microwave spectroscopy, Rotation of molecules, rotational spectra, diatomic and polyatomic molecules, Infrared spectroscopy,: the vibrating diatomic molecule – simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating rotator – CO molecule. Interaction of rotation and vibrations, the vibrations of polyatomic molecules and their symmetry,

Raman spectroscopy: pure rotational and vibrational spectra, techniques and instrumentation, the influence of rotation on the spectra of linear molecules – Electronic spectra of diatomic molecules – Born-Oppenheimer approximation, vibrational coarse structure – progressions. Intensity of vibrational transitions – the Franck-Condon principle. Dissociation energy and dissociation products. Rotational fine structure of electronic-vibrational transitions – the Fortrat diagram.

Unit 3:X-RAY SPECTROSCOPY

X-rays: waves and photons, Generation of X-rays, X-ray tubes, Rotating anode, Synchrotron radiation from circular arc, Undulator and Wiggler radiation. **[3L+1T]**

X-ray Scattering: One electron scattering, Scattering from an atom, Scattering from a crystal, Scattering from liquids and glasses, Small angle scattering **[4L+1T]**

Phase Transitions and Critical Phenomena
[PHO-312]

1. Phenomenology of phase transitions [5L+1T]

The role of symmetry and the onset of order, Switching of the degree of order, Example of atomic site ordering, Ferroelectric phase transitions, How to observe a phase transition, Order of a phase transition, General aspects of the thermodynamics of a phase transition, Seeds of a theoretical model, Examples

2.Magnetic phase transitions [5L+1T]

Macroscopic and microscopic views of magnetism, Non-interacting atoms in a magnetic field: paramagnetism, Interacting atoms in a magnetic field: ferromagnetism, Critical exponents revisited, Successes and failures of the mean-field model

3. Landau theory [12L+2T]

Introduction, Quantification of the free energy, Results for second-order phase transitions, Field-dependence of the order parameter at the transition temperature, Taking account of spatial variations, Validity of Landau theory, Ferromagnetism, the mean-field approximation, and Landau theory, First-order phase transitions, the case when the free energy is allowed to have odd-order terms, Tricritical phase transitions. Examples like phase transitions and elastic strain, ferroelectric phase transition, superfluid Mott insulator phase transition.

4. The role of symmetry[12L+2T]

Introduction to Symmetry, Point group symmetry operations, Space group symmetry operations, Groups and their representations, Symmetry of the order parameter, Symmetry of the spontaneous strain, Group-subgroup relationships across phase transitions

5. Soft modes and displacive phase transitions[4L+1T]

Displacive phase transitions, Phenomenology of the soft mode model of displacive phase transitions, Lattice dynamics theory of the soft mode, Lattice dynamical theory of the low-temperature phase, Phase transitions, soft modes, and structure flexibility: the Rigid Unit Mode model

6. Order-disorder phase transitions[4L+1T]

Order–disorder phenomenology, Mean-field theory of order–disorder phase transitions: the Bragg–Williams model, Computational methods, Beyond Bragg–Williams theory: the Cluster Variation Method

7. Critical point phenomena[4L+1T]

The Widom scaling hypothesis: relationships between critical exponents, Introduction to the renormalization group, deriving the Widom scaling hypothesis,a sketched example: the 1D Ising model

8. Reconstructive Phase transitions[4L+1T]

Introduction and definition, Examples, Thermodynamics of reconstructive Phase transitions