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MAHARAJA SURAJMAL BRIJ UNIVERSITY

Bharatpur (Raj.)

SYLLABUS AND ORDINANCES

OF

M.Sc. PHYSICS

Based on Choice Based Credit System (CBCS)

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Session 2021-2022 & Onwards

(Dr. Divyanshu Bhatnagar)

REVISED COURSES AND SYLLABI OF M.Sc. PHYSICS (for Academic Session 2021-22 Only)

MAXIMUM MARKS WEIGHTAGE AND CREDIT POINT AWARDED TO EACH COURSE FOR M.Sc. PHYSICS

[BASED ON CHOICE BASED CREDIT SYSTEM (CBCS)]

COURSES CODE	COURSE TITLE	Teaching Hrs/Week	Credits	Periodic Tests	Assignments / Seminars	Term Exam.	Min./Max. Marks
SEMESTER – 1st							
MSP-C 1.1	Mathematical Methods in Physics	6	4	20	20	60	40/100
MSP-C 1.2	Electronics	6	4	20	20	60	40/100
MSP-C 1.3	Electromagnetic Theory	6	4	20	20	60	40/100
MSP-C 1.4	Computer Fundamentals	9	6	30	30	90	60/150
Total Marks & Credits of 1st Semester			18				180/450
SEMESTER – 2nd							
MSP-C 2.1	Classical Mechanics and Statistical Physics	6	4	20	20	60	40/100
MSP-C 2.2	Communication Electronics	6	4	20	20	60	40/100
MSP-C 2.3	Computer Programming	6	4	20	20	60	40/100
MSP-C 2.4	PRACTICALS	9	6	-	-	150	60/150
Total Marks & Credits of 2nd Semester			18				180/450
SEMESTER – 3rd							
MSP-C 3.1	Quantum Mechanics	6	4	20	20	60	40/100
MSP-C 3.2	Atomic and Molecular Physics	6	4	20	20	60	40/100
MSP-C 3.3	Elective Course: Any One	6	4	20	20	60	40/100
(a)	Microwave Physics						
(b)	Optoelectronics						
MSP-C 3.4	PRACTICALS	9	6	-	-	150	60/150
Total Marks & Credits of 3rd Semester			18				180/450
SEMESTER – 4th							
MSP-C 4.1	Nuclear and Particle Physics	6	4	20	20	60	40/100
MSP-C 4.2	Solid State Physics	6	4	20	20	60	40/100
MSP-C 4.3	Elective Course: Any One	6	4	20	20	60	40/100
(a)	Nanomaterials and Nanoscience						
(b)	Solar Energy Physics						
MSP-C 4.4	PRACTICALS	9	6	-	-	150	60/150
Total Marks & Credits of 4th Semester			18				180/450
Total Marks & Credits of 1st, 2nd, 3rd & 4th Semesters			72				720/1800

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MSBU Residential M.Sc. (Physics) Syllabus for Session 2021-22 Only

Course: MSP-C 1.1 Mathematical Methods in Physics

Unit-1

Dimensional analysis, Vector algebra and vector calculus, orthogonal curvilinear coordinate systems, Linear vector space, Matrices, Cayley Hamilton theorem, eigenvalue problems, diagonalization of matrices.

Unit-2

Linear differential equations, Special functions (Hermite, Bessel, Laguerre, Legendre and Hypergeometric).

Fourier series, Fourier and Laplace transforms; Elements of complex analysis; Laurent series-poles; residues and evaluation of integrals.

Unit-3

Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule; solution of first order differential equations using Runge-Kutta method; Finite difference method.

Course: MSP-C 1.2 Electronics

Unit-1

Semiconductor device physics including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications. Optoelectronic devices, including solar cells, photodetectors and LEDs.

Unit-2

Operational amplifiers and their applications

Unit-3

Digital techniques and applications (registers, counters, comparators and similar circuits), A/D and D/A converters.

Course: MSP-C 1.3 Electromagnetic Theory

Unit-1

Laplace and Poisson equations, Green function and Delta Dirac function, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem.

Unit-2

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Electromagnetic Induction, Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces, Scalar and vector potentials; Gauge invariance. Electromagnetic waves in free space, dielectrics and conductors.

Unit-3

Reflection and refraction, polarization, Fresnel's law, interference, coherence and diffraction.

Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

Course MSP-C 1.4 Computer Fundamentals

Unit-1

An introduction to computer system, Generation, Types and Applications of computers in various fields

Unit-2

Hardware features and their uses, CPU, I/O devices, storage media etc.

Unit-3

Various categories of software; Operating systems and their functions.

Course: MSP-C 2.1 Classical Mechanics and Statistical Physics

Unit-1

Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces.

Unit-2

Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Hamilton-Jacobi theory, Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates.

Unit-3

Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law, Bose-Einstein condensation; Random walk and Brownian motion.

Course: MSP-C 2.2 Communication Electronics

Unit-1

Basic principles of amplitude modulation, frequency modulation and phase modulation, demodulation.

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Unit-2

Radio transmitters and receivers, classifications and applications of transmitters and receivers, Transmission lines-types and parameters, transmission line equation, input and output impedances, characteristic impedance, reflection coefficient and VSWR, Smith chart-types and applications.

Unit-3

Basic concept of guided waves, types of waveguides, transmission line analogy for waveguides, propagation phenomena in different types of waveguides.

Course: MSP-C 2.3 Computer Programming

Unit-1

Fortran programming language

Unit-2

Introduction to programming in 'C' language

Unit-3

Mathematical modeling

Course: MSP-C 2.4 (Lab. 1: Electronics Laboratory)

List of Experiments (Any Thirteen):

1. Study and designing of Half Wave Rectifier and determination of their various parameters.
2. Study and designing of Full Wave (Centre-trapped) Rectifier and determination of their various parameters.
3. Study and designing of Full Wave (Bridge type) Rectifier and determination of their various parameters.
4. Study of V-I characteristics of a PN junction diode.
5. Study of V-I characteristics of a zener diode.
6. Study of V-I characteristics of a LED.
7. To assemble and study Regulated power supply.
8. Study and designing of L-type and π-type Filters.
9. To study the LCR circuits.
10. Study and designing of High-pass and Low-pass Filters.
11. To assemble and study Feedback Amplifier.
12. Study and designing of RCC Amplifier.
13. Study and designing of Transformer Coupled Amplifier.
14. Study of CRO and its deflection sensitivity.
15. To generate and study of Lissajaous figure with the help of CRO.
16. To assemble and study CB-characteristics of PNP/NPN transistor.
17. To assemble and study CE-characteristics of PNP/NPN transistor.

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18. To study the FET characteristics.
19. To study the UJT characteristics.

Course: MSP-C 3.1 Quantum Mechanics

Unit - 1

Wave particle duality, Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schrodinger equation (time-dependent and time-independent); Eigenvalue problems such as particle in a box, harmonic oscillator etc.; Tunneling through a barrier.

Unit – 2

Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine-structure.

Unit – 3

Time independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule, Sudden and adiabatic approximation, Selection rules.

Course: MSP-C 3.2 Atomic & Molecular Physics

Unit – 1

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen.

Unit – 2

Hyperfine structure and isotropic shift; width of spectral lines; LS and JJ Coupling; Zeeman, Paschen Back & Stark effect.

Unit – 3

X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules, Spontaneous and stimulated emission, Einstein A & B coefficients. .

Course: MSP-C 3.3 (a) Microwave Physics

Unit – 1

Microwave Band and its application, basic microwave concept, characteristic features of microwaves; Limitation of conventional tubes, microwave tubes- klystrons, magnetron, travelling wave rube (TWT).

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Unit – 2

Solid state microwave sources- bipolar transistor, field effect transistors, transferred electron devices, avalanche effect devices; Microwave network representation, scattering matrix, properties of scattering matrix, scattering matrix consideration, measurement of scattering coefficients, S-matrix for some typical network.

Unit – 3

Microwave measurement detection of microwaves, power measurements, Impedance measurement, Frequency measurement, Scattering parameters, Measurement of VSWR and dielectric constant; Microwave components-impedance transformers, microwave filters, Directional Couplers; Ferrite and tensor permeability, wave propagation in ferrite medium, faraday rotation in ferrites, isolator and circulator.

Course: MSP-C 3.4 (Lab 3: MICROWAVE AND COMMUNICATION)

List of Experiments (Any Eight):

1. To study detection efficiency of diode.
2. Study of Differential Amplifier and determination the CMRR.
3. To assemble and study the Hertley Oscillator.
4. To study the SCR characteristics.
5. To study the Reflex Klystron Tube.
6. To study of Gunn Diode.
7. Verification of Fourier Theorem.
8. To study and verify the Thevenin's Theorem.
9. To study and verify the Reciprocity Theorem.
10. To study the Horn Antenna and determine various antenna parameters.
11. To determination the VSWR and Reflection Coefficient.
12. To study the Operational Amplifier.
13. To determine the various parameters with the help of Optical Fiber Kit.

Course: MSP-C 4.1 Nuclear and Particle Physics

Unit - 1

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; charge-independence and charge-symmetry of nuclear forces; Isospin; Dueteron problem.

Unit – 2

Evidence of shell structure, single-particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions.

Unit – 3

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Classification of fundamental forces; Elementary particles (Leptons and Hadrons); Quartz model of particles, spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

Course: MSP-C 4.2 Solid State Physics

Unit - 1

Bravais Lattices; Reciprocal Lattice, diffraction and the structure factor; Bonding of solids.

Unit - 2

Elastic properties; phonons, lattice specific heat, Free electron theory and electronic specific heat; Response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power.

Unit - 3

Diamagnetism, paramagnetism and ferromagnetism; Electron motion in periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, Type- I and type – II superconductors, Josephson junctions, high T_C superconductors.

Course: MSP-E 4.3 (a) Nanomaterials and Nanoscience

Unit - 1

Introduction and Concept of Nanomaterials and Nanoscience, Types of Nanomaterials including nanocomposites and nanoporous materials: shape, structure and properties, Electrical and magnetic properties of nanoparticles.

Unit - 2

Quantum mechanics and Jellium model of nanosystems, Properties of nanomaterials special reference to Surface properties and mechanical properties.

Unit - 3

Stabilization of nanoparticles, Carbon based nanomaterials, Fullerenes, Graphenes and Nanotubes.

Course: MSP-C 4.4 (Lab 4: SOLID STATE PHYSICS)

List of Experiments (Any Eight):

1. To determine the Energy Gap of semiconductors.
2. To study the Hall Effect Experiments.
3. To determine the velocity of the liquid crystal with the help of strip chart recorder by Ultrasonic Pulse Echo interferometer.
4. To determine the Heat Capacity of the different materials.

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5. To determine the thermal characteristics of the materials.
6. To determine Refractive index of the glass materials.
7. To measure the Rigidity and Internal Function of solids by Helmholtz Coil with stand light scale.
8. Study the B-H Curve.
9. To determine the Dielectric Loss by using CRO.
10. To determine the Ultrasonic Velocity and Attenuation in liquids.
11. Study of Hysteresis loop Tracer without computer interface.
12. To determine various parameters using Four Probe Set Up.

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REVISED ORDINANCES OF MASTER OF SCIENCE (M.Sc.) IN PHYSICS

(w. e. f. Academic Session : 2020-21)

1. The title of the M.Sc. course shall be M.Sc. Physics. The Course shall be conducted by the Department of Physics

2. The minimum qualification for admission to the M.Sc. Physics shall be Bachelor's degree (Three Year) with at least 50% marks in aggregate with Physics/Instrumentation/Optical Instrumentation/Biophysics as one of the subject.

3. The admission of the candidate shall be based on academic merit and interview /written test.

4. The M.Sc. Physics course shall be of two years (divided into four Semesters) programme and based on Choice Based Credit System (CBCS). The first year of M.Sc. shall be known as M.Sc. (P) having I and II semesters. Similarly, second year of this course shall be called M.Sc. (F) having III and IV semesters. Each semester shall consist of minimum 90 working days.

5. The M. Sc. programme is spread over four semesters.The total marks assigned for this programme shall be 1800 and the credits earn will be of 72 credit points and comprises of three different components viz. I) Teaching and II) Lab Work / Field Work. Distribution of credits for M. Sc. Programme as :

   I) Teaching and Seminar /Tutorial = 48 credits
   II) Lab work/ Field work/Project = 24 credits

6. For each semester, there shall be three theory papers, in addition to laboratory work and Assignment/Tutorials/Seminars.

7. The Assignment/Tutorials/seminar shall be conducted by the teachers concerned and Head of the Department.

8. At the end of each Semester there shall be a End-Term Examination of three hours duration for each course and practical of six hours, based on prescribed courses taught during the Semester.

9. At least one question paper of each semester shall be set and examined by External Examiner and the remaining papers by the Internal Examiners. The practical examination at the end of each Semester shall be conducted by a Board of two examiners (one external and one internal examiner) jointly.

10. The examiners- external as well as internal shall be appointed by the Vice- Chancellor on the recommendation of the Head of the Department.

11. Each core or elective course in each semester shall be of 100 marks (4 credits). Out of these marks, 20 marks in each course shall be awarded on the basis of atleast two periodical tests to be conducted by the teacher concerned during the semester and in addition twenty marks shall be awarded on the basis of assignment/seminars in each theory

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paper. At end of each semester there shall be a term examination of each course and the same shall carry 60 marks. The practical examination shall be of 150 marks at the end of each semester. The marks shall be awarded jointly by the internal and external examiners on the basis of practical examinations, viva-voce and records.

12. The teachers teaching a particular paper or parts there of, shall provide in writing the details of the topics taught or to be taught in a given semester. These details along with syllabus and Questions Bank (if any) shall be sent to the examiner for setting the question paper.

13. In case of misbehaviour, indiscipline, the student may be expelled from the Department or given some other punishment recommended by the faculty members of the Department / Proctor of the University and the decision of the unfair means committee of the university is final in the case of cheating and using unfair means by the student in any examination. All cases of expulsion shall be referred to the Vice-Chancellor for final approval.

14. Each student shall pay tuition, examination and other fees per semester/annual as University Orders.

15. (a) Each theory paper of the Course shall contain 8 (eight) questions spread uniformly over the entire syllabus. The students shall have to answer only 5 (five) questions in three hours, which shall be the dur..ion of the question paper.

(b) A student must get at least 40% marks in each theory paper including periodical tests and assignment/seminars in each Semester for being eligible for promotion to the next Semester. Further, he/she must get at least 40% marks in the practical examination. To pass the course the candidate should secure at least 40% marks in the aggregate.

16. A student who fails or want to improve in theory paper/(s) or periodical test/(s) shall be given only one chance to reappear in that paper along with the next following batch. The chance to reappear shall be given only in not more than two courses in one Semester. The candidate shall, however be promoted to the next Semester. No separate examination will be conducted for such candidate.

17. If a candidate fails to appear in practical examination, a special practical examination can be conducted for the candidate on the deposition of fees as prescribed by the university as a special practical examination fees.

18. A student may appear as an Ex-student in the term/semester examination provided that :-

(a) He /She has completed all the semester examination, test and seminars but failed in aggregate of all the semester examination.

(b) He /She has attended 50% of lectures, practical, appeared in tests and seminars and he/she has submitted the Medical Certificate with an application on the first day of the term/semester examination or prior to this.

19. If a candidate has secured 60% or more marks in the aggregate in all the four semester he/she will be placed in First division. If he/she secured 50% or more but less than 60% will be placed in Second division. If he/she secured less than 50% marks will be placed in Third division. If a candidate has secured 75% or more marks in the aggregate of all the four

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Semester examinations counted together, it shall be mentioned in his Degree that he has passed M.Sc. Examination with Distinction.

20 Every candidate will be required to have 75% attendance of the prescribed number of periods in each paper. Teaching/ Seminars/ Tutorial/ Library Reading shall be of one-hour duration and will be c unted as one attendance. Practical of 2-3 hours will also be counted as one attendance.

Exemption in the prescribed number of attendance may be granted by the Vice-Chancellor on the recommendation of the Head of the Department in case of following circumstances.

The student should be a sportsman or sportswoman who have participated in games upto the level of National/ Inter-University/ Camps/ Tournaments and Youth Welfare Activities.

Inspite of exemptions clarified above it will be compulsory for a candidate that he/she has attended at least 60% prescribed number of periods.

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